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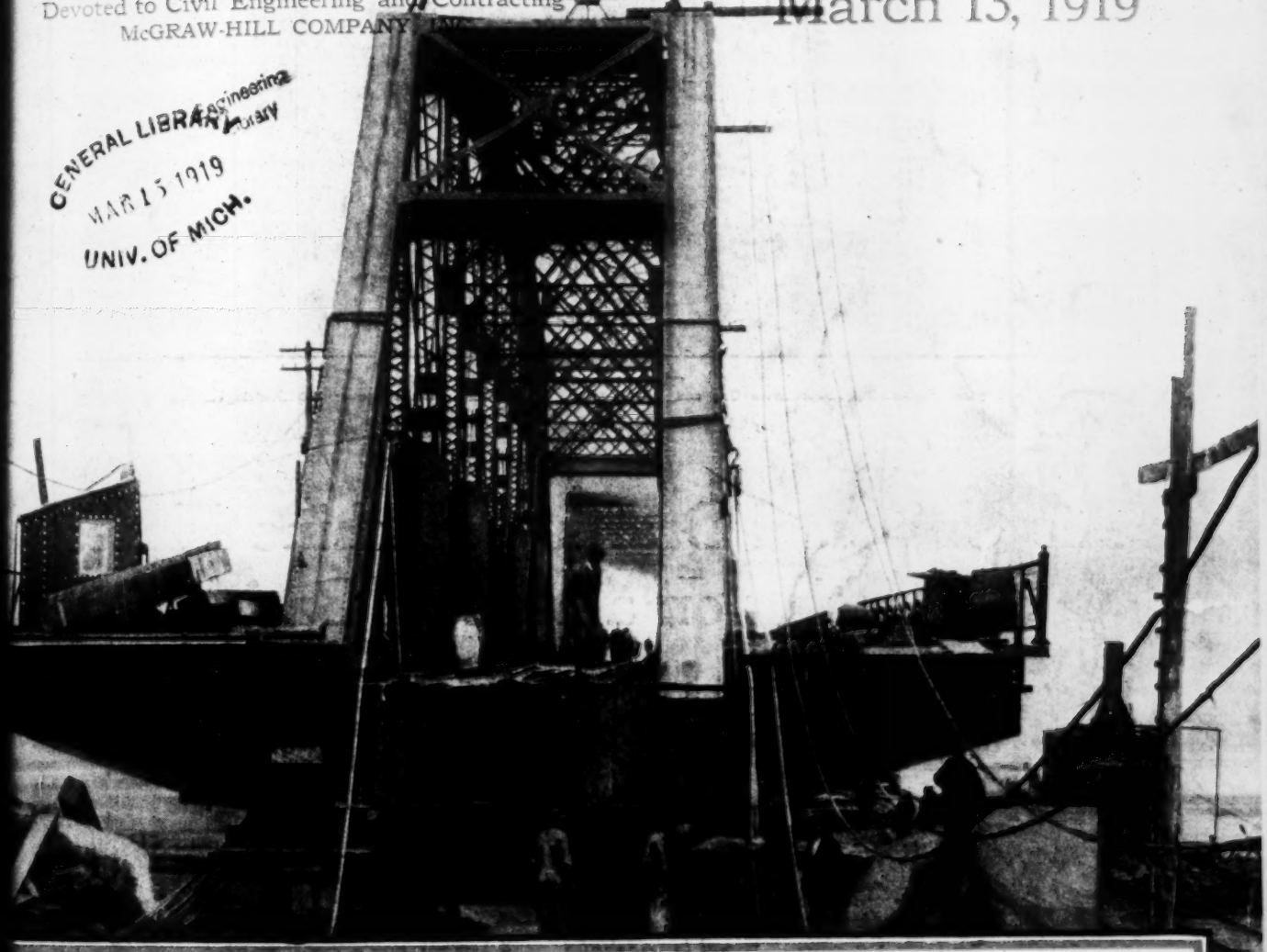


ST. JOSEPH BRIDGE: How railway equipment played a part in bridge construction is described in this issue. When the Union Pacific rebuilt its Missouri River bridge at St. Joseph, three 300-foot spans had to be shifted endwise 136 feet to their new piers. Freight-car trucks were set under them, and multiple tackle of 1½-inch manila rope hauled them along tracks laid on the falsework.

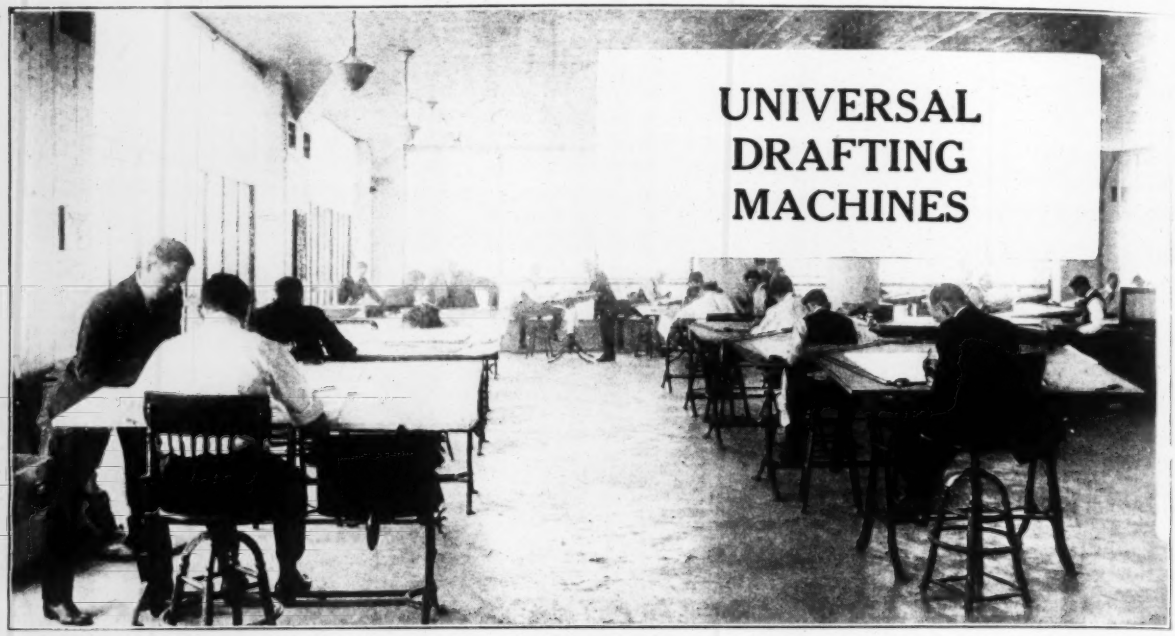
AFTER studying the many recent plans for solving the railway problem, L. C. Fritch, in this issue, suggests Federal incorporation with Government representation on directorates; two strong competing railway systems in each of the 17 regional districts; regional rate and wage boards, with a supreme Federal railway-control board; and Government guarantee of income.

Operation of Cleveland Freight Terminal

By W. E. PHELPS

Comprehensive Scheme for Grade-Crossing Elimination at Detroit

Chicago Union Station Work for 1919



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ENGINEERING NEWS-RECORD

A WEEKLY JOURNAL
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Under the Shadow of the Railroad Problem

NEXT week the American Railway Engineering Association will hold its annual meeting. It meets at a most extraordinary time for the industry to which its labors are devoted. Last year, it is true, the railroads were under Government control. But they had only recently been taken over, policies were necessarily unformed, and the war was in progress. Now we have had over a year of Government operation. Moreover, the war being ended, the disposal of the properties has become one of the big problems of the day. The multitude of financial, legislative and regulatory questions raised by the situation will not come before the association in a formal way, but the confusion and the serious condition in which the railroads find themselves will inevitably overshadow the meeting and give it a tone more serious than would come merely from the discussion of technical questions. Moreover, the obligation which these straight-thinking men have in the rehabilitation of the railroads, which they and their predecessors have helped to create, cannot but impress itself upon them individually and collectively. Theirs is the type of thinking—the impartial analysis of all factors, even the social ones—which must prevail if the railroads are to be brought to better days. Had the thinking on top in railroad management been as solid and sane as the admirable committee work of the association, we should not have come to the present pass in railroad matters. Certainly, the work of the association looms greater now than ever, for the roads in the time of rehabilitation will have need for all the economies which engineering skill can possibly devise. That thought surely will soberly overshadow the meeting next week.

Public Work More Than Ever the Duty of the Cities

IF THE Governors' and mayors' conference at Washington accomplished little else, it certainly impressed the delegates with the necessity of getting busy each in his own city and state. No better time could have been selected for revealing the breakdown of the national Government in the reconstruction crisis. The 65th Congress was talking itself to death in a whirlwind of masterly inactivity, while the delegates were listening to depressed Federal officials explaining what they would have done had Congress acted. The President, his mind still in Paris, referred to this country's problems only to shift them onto the shoulders of the states and the cities. With few exceptions, the Governors did not show that they were alive to the situation, or that any help might be expected from them, but the mayors—being closer to the people—gave promise of action. After all, they are, in this matter, the more important of the two classes of official. Now that all hope of Federal public works for buffer employment is gone—for many months, at least—it is the cities which must step into the breach and start the street paving, the bridges, the sewers, and the water supplies, which will not only furnish work to the unemployed but give the initial impetus to business activity. No one knows this now better than the mayors of our cities. Let us hope that they will have the coöperation of every contractor and material man, particularly in giving them the best possible prices future conditions will allow. It is the duty of everyone to go as far as he can to stimulate the revival.

Enriching the Literature of Engineering

WHEN the tree is mature and its fruits are mellow, then should the fruits be picked and not be allowed to waste. Engineers and constructors there are, however, who come to maturity, who produce bounteous and splendid fruits of an intellectual and constructional kind, but never share them with others. The fruit-tree analogy is not exact, for these intellectual and constructional fruits are not wasted. They find embodiment in worthy structures. But hundreds—aye, thousands—might know of these works and profit by them, instead of the dozen who now have the knowledge. The difficulty is that these men do not take the time to record and publish their researches and experiences. This train of thought is prompted by the article by R. Fleming in this week's issue of *Engineering News-Record*. For some years Mr. Fleming has been pursuing a policy of setting down the experiences of a lifetime for the benefit of his professional brethren. The tree is mature. The fruit is mellow and of splendid quality; it is here set out that all may take and profit. Other instances might be cited, such, for example, as that wonderful article on slow-burning mill construction in *Engineering News-Record* of Dec. 27, 1917, in which F. W. Dean compressed a lifetime's experience into a few pages. But where one such instance can be cited there are, unfortunately, a dozen where experience that future generations might use will go down into the grave. Is there here not a duty as well as an opportunity? We are all heritors of the ages. Shall not the treasury of engineering knowledge be made richer because we have lived?

Grade-Crossing Problems Demand Coöperation

COÖPERATION rather than controversy should mark the solution of grade-crossing elimination, according to the Detroit report abstracted on another page. This is a principle which other cities and all

railways might well take to heart. In all such work the city gains safety and convenience for its citizens and commerce and usually an improved appearance along the railway lines. The railway gains by saving continual expense for watchmen, gates and damages, and also in freedom of operating its traffic. Certainly, as the report says, the city should pay a fair share of the expense on the ground that systematic elimination of grade crossings is a general public improvement. Discussion of principles and general policy rather than of details is a characteristic of this report which adds to its weight and value. Much of the matter applies to the problem in general as well as to the local condition of Detroit, and it would be well for other cities which have this problem before them to investigate it in the same broad and comprehensive manner.

Compensation Laws and Accident Prevention

THE economic urgency of greater safety in construction is made clear by the steady progress of the movement to compensate industrial workers for accidents, without suits to prove negligence of employers. According to a bulletin recently published by the United States Bureau of Labor Statistics six new states adopted compensation legislation during 1917 and 1918. Only 10 states are now without such legislation. Naturally, compensation laws vary greatly in character, and some of them are partial and crude, compared with others. All, however, place the burden of cost for accident squarely on the employer. To reduce the frequency and severity of accidents and thereby reduce the charge against his business for accident compensation, is the employer's problem. Contractors need particularly to visualize this fact. Construction has been the laggard among industries in practicing accident prevention. This is not because contractors are callous to humanitarian appeal. Nor is it because they are not aware of the responsibilities which workmen's compensation laws place upon them. It is chiefly because they have not been convinced that systematic safety engineering costs less than accidents. Partly, also, it is because few contractors know just what procedure to follow to educate their organizations and their workmen in "safety-first" practices. In both these problems, contractors can obtain material help from the Construction Section of the National Safety Council, whose headquarters are in Chicago.

The Railroad Plans Before Congress

IN EVERY quarter the railroad problem is recognized as one of the biggest and most pressing of the day, for it involves not merely the rights and property of thousands of citizens but the welfare of the entire community as well. Consequently, it was to be expected that when Congress, through one of its committees, announced that it was ready to hear all parties at interest, many plans and much opinion would be offered. To most of us the multiplicity of plans is confusing. Fortunately, one who has followed the testimony closely, who has studied and compared the various plans and whose standing and long railroad experience give to his words unusual weight, has prepared a discussion of the merits of the outstanding features of the various plans. It appears on p. 504 of this issue.

A presentation of each of the principal plans in detail would, naturally, run into much space. Mr. Fritch has chosen, accordingly, the logical procedure of taking up those points which are common to a number of suggestions, arguing that the greater merit is likely to rest with the plans emanating from the majority of thinking proponents. As a result of his discussion, Mr. Fritch leaves us in possession of a composite plan, covering all of the chief phases of the problem.

That plan, as he sets forth, is calculated to safeguard the rights of the two parties to the controversy—the owners of railroad securities, on the one hand, and the public, on the other. It provides for private ownership (a feature, happily, that was strongly endorsed at the recent White House conference of Governors and mayors) but for close Government control. The latter is designed to protect the public's interests, while those of the stock and bondholders would be taken care of in the valuation and in the guarantee of a reasonable return.

The problem, obviously, is not one easy of solution, nor is there likely to be much good result from a multitude of suggestions until these have been boiled down, compared and digested. As a contribution toward a better understanding of the problem as it now stands before the Congressional committee, Mr. Fritch's analysis and discussion are a most helpful addition.

Engineers' Salaries vs. Mechanics Wages

ILLUSTRATING the relation between salaries being offered engineers and the wages thought necessary to attract miscellaneous clerical and mechanical workers, a subscriber sends us some "Help Wanted" advertisements from the New Orleans *Times-Picayune*. The first item reads: "Man with knowledge of civil engineering: must own or control surveyor's instruments; to make plans and lay off surface drainage ditches and levels; prefer one familiar with concrete work; employment in city; salary $30 weekly." The second calls for a druggist and stenographer at the same salary, $30 per week; the third, for a shoemaker to do machine work at the same rate, and the fourth for shipfitters, coppersmiths and patternmakers for the Panama Canal at from $1 to $1.11 per hour.

Our first inclination was to remark that comment upon such a situation would be superfluous. However, following the lines of Mr. Goodell's letter in last week's issue, is it not worth while to distinguish in the engineer advertisement between those qualifications which require a high grade of training and those which do not? Had the advertiser omitted the words "to make plans," is it not possible that the offering of only $30 a week might secure the services of some younger man who might serve very well in the capacity and at the same time be not seriously underpaid? We think that $30 a week is far too little for a competent surveyor, but surely this compensation would appear more equitable to a man with surveying experience only than to one who had put in four years at college and had piled up experience in addition. The moment, of course, that the advertiser injected the statement that the incumbent must be able to make plans for drainage ditches he raised the requirements so materially that the salary he offers is absurd. Even so, we have heard some who would question whether the simpler jobs in civil engineering design might not be handled by men who after leaving high school had apprenticed themselves in an engineering office.

The point is that instead of condemning those who offer low compensation for minor engineering work, it is our duty to examine into the nature of the work, to analyze and distinguish as Mr. Goodell counseled, and frankly recognize which classes of work may be done with comparatively little school training and experience, and which, on the other hand, require a high degree of technical education and long experience. When we have done that and have secured a recognition among ourselves of the different elements of civil engineering work, we will be in a position to influence more intelligently the compensation that should be paid those who engage in engineering work.

Letting Road Contracts in Long Stretches

FOR some years the thought has been crystallizing that the best interests of the public would be served by letting some of our road contracts in long stretches. The past practice of short-length contracts has been due to the fact that methods were primitive, permitting the completion in a single season of only a relatively short piece of road. Quite naturally, then, the contracts tended to be limited in extent by the length of road normally laid in a season's work. This limitation, in turn, made it possible for men with small capital to take contracts, while the relative simplicity of the operations was an invitation to men of little experience to engage in road contracting.

Now conditions have changed, yet the contracting system remains relatively unaltered. In an era of expensive road types, with plant available to build rapidly, we still persist in letting contracts in lengths determined by the days of little machinery and less expensive types. The result is that there are scores of small contracts, each carried by a separate organization, while strong firms able to "plant" a job adequately and to handle a large mileage under one contract are kept out of highway work. In consequense, the public loses the savings that invariably come when a well-coordinated, big organization replaces a lot of independent, small ones.

Nor does the disadvantage lie solely in the losses due to higher costs. There is a real menace in the situation. We are embarking on a very extended highway program. This year, already promising to be of good volume, is but an introduction to a succession of years of extreme activity. The people will make the funds available to the limit of the highway engineers' ability to use them. If we persist in the methods of a bygone decade, the limitation to road-building may be serious to the whole country.

It is well known that many strong contracting organizations which have not heretofore done highway work have been studying carefully the highway-contracting situation. They are not merely ready, but anxious, to engage in this new line of work, but always they meet with the same discouragement—short-length contracts, making it impossible to cover a big mileage in one operation, and to make an investment in expensive plant. These organizations are able to take thirty- and forty-mile stretches and to put on the work one or more outfits—each costing from $30,000 to $50,000—and capable of completing a mile of road a week. With the great extension of highway improvement which is imminent, such handling is going to be inevitable, but why wait two or three years and bear the loss and setback certain with the old system?

In some places laws must be changed to permit the letting of such long contracts, but surely the people who vote large road-bond issues are willing to approve whatever is necessary for the efficient expenditure of the funds.

It must not be thought that adoption of the policy here advocated requires the elimination of all short-length highway work. In all state and county systems there are many short, unimproved sections which must necessarily be let under short-length contracts. This is particularly true of county work. In fact, it is certain that with the renewed highway activity the number of these short, unimproved sections is great enough to keep the efficient small contracting organizations hitherto engaged in highway work. These contracts, too, afford an avenue through which capable construction men can build up to the point where they, too, can take the thirty- and forty-mile stretches here advocated. Futhermore, there will always remain as inviting work for the smaller organizations the construction of the less expensive types, in which a much larger mileage can be made in a construction season than with the improved types now being used on trunk lines. We have no fear, therefore, that the adoption of a policy of long-length contracts will tend to close the door of opportunity to those now engaged in a small way in highway work or who contemplate entering this field.

It is worth while noting, too, that large contracting organizations hitherto engaged in other classes of work—such, for example, as buildings—will have much to learn if they are to execute the jobs with maximum efficiency. The type of mentality needed for success in highway construction is somewhat different from that used on building operations. On the latter work the operations are confined within a small area and can be closely supervised with relatively small overhead organization. Moreover, the compactness of the work enables one or two men to watch the sequence carefully, in order that there may be no delays between the successive phases of the operation. On highway construction the work is scattered over many miles, receiving points for materials often being located pretty far away from the actual work of laying the pavement. The type of mentality required in railway construction is more likely to fit in with highway work than is that which has hitherto attained success in such concentrated operations as the erection of buildings or industrial plants. Obviously, the wise course of procedure for big organizations new to highway construction will be to introduce into their organizations experienced roadbuilders and to support and back them with all of the resources of the large organization. Without a doubt, these big companies have much that can be added to highway work, with an assured increase in efficiency, but they have also much to learn regarding the detailed handling of pavement-construction operations.

The crux of the whole matter, however, lies in the traditional methods of letting highway construction in short lengths. Highway engineers generally, our inquiries indicate, believe in the necessity of the long-length contract, but are bound down either by legislation or by the prejudices of those in their organizations who appreciate less keenly the radical change which has come about in highway work. Under the urge of the large programs now maturing, even the conservatives may be brought to a realization of the inadequacy of past methods and adopt a policy that accords better with the new situation.

A Solution of the Railway Problem Based On Plans Presented to Congress

Discussion of the Salient and Common Features of the Various Proposals, in the Light of Experience and of the Equities Involved

By L. C. Fritch
M. Am. Soc. C. E., Past President American Railway Engineering Association, Chicago

THERE have been upward of fifty plans submitted to the Congressional committee which has been investigating the railway problem, and there will probably be many more before the investigation is closed. With all the data in hand Congress should be able to devise a plan which will embody features that will deal equitably with the various interests concerned and give effect promptly to such legislation as is necessary to place the transportation industry on a sound basis.

The natural assumption of the advocates of plans is that their particular plans are the best, but on careful analysis of the different proposals it becomes apparent that the particular interests suggesting a plan give prominence to those elements which best safeguard their interests. There are many points on which various plans agree, but not a single plan thus far proposed offers a complete and satisfactory solution of the whole problem. A composite embodying the best features of the various plans must ultimately be adopted, and in the drafting of such a plan all selfish interests must be submerged.

It is the purpose of this review to bring out the salient and common points of the various plans, to discuss them in the light of experience and of the rights and equities involved, and as a result to evolve a composite that will be fair to all.

Ownership, Control, Management, Operation

Ownership—The ownership of the railways is vested in the stockholders, representing millions of individual holders, many of them small owners, including women and children who depend upon the dividends for their support. The property rights of these people must be safeguarded, for these interests were honestly acquired.

The ownership should be left with the people—in private hands. Government ownership is recommended in only one plan, that of organized labor, and for the sole purpose of enhancing their interests without regard to the other interests concerned. Government ownership would mean a demoralization of the railway systems and make it a political spoils system with all its attendant evils. If Government ownership were made the issue before the people, it would meet with overwhelming defeat; so one is justified in concluding from the tenor of the plans presented. That which does not meet with public approval can be safely eliminated from the plan.

Corporate Organization—The ownership having been determined, the next step is the proper form of organization of the railway systems.

The predominating view is that railways should be incorporated under a Federal act. Some plans advocate that this should be compulsory, others voluntary.

One of the main difficulties confronting the railways now is the multiplicity of governing bodies controlling their operations. With the Federal Government and the 48 states making laws governing railway operation, it is plain that much confusion and expense must result. It is reasonable to expect that a single authority governing the operation of an industry which is similar all over the country would produce better and more efficient results than 49 authorities. The difficulty can only be overcome by incorporating interstate railways under a Federal act, not depriving the states of such rights as will not conflict with the Federal authority. While it is held by some legal authorities that Federal incorporation would be unconstitutional, others hold the contrary view. Certainly, if prohibition can be made constitutional by an amendment, Federal incorporation of railways, which is infinitely more vital to the welfare of the country, can be made possible.

Federal incorporation *must* be adopted to place the industry on a sound basis.

Government Control—The majority of the plans recommend some form of Government control. This principle is so well established, and has been demonstrated to be so essential, that it can be safely included in the ultimate plan. The open question is as to the form and extent of this control. The Interstate Commerce Commission is now the main Federal controlling body, but its functions are limited by law. The blame often attached to the commission for the present condition of the railways may not be laid upon the commission, but upon the law prescribing its functions. The fact remains that the commission as now constituted is not empowered to perform the functions which should belong to an adequate Federal controlling body, and it will be necessary to enlarge the powers and functions of the commission or create a new board of Federal control to meet the situation.

Various plans recommend the creation of a Department of Transportation, the head of which should be a member of the President's cabinet. It would assume the powers of the Interstate Commerce Commission. Some recommend the enlargement of the commission by creating regional commissions; others recommend no change in the present commission's organization. Strong objections are made to the appointment of a Secretary of Transportation, on the ground that it would result in political control over the transportation industry, a situation which should be avoided.

The predominating view calls for the creation of a Federal Railway Control Board with ample power to exercise public control over railways, such a board to be either an enlargement of the powers and composition of the present Interstate Commerce Commission or an entirely new body. The state commissions need not necessarily be abolished, but should act in coöperation with the Federal Board of Control, exercising such powers as are not in conflict with the Federal authority.

The public will demand and has a right to require close Government supervision over the railways.

Management—The management of the corporations should be vested in a board of directors. The composition of the board is the subject of wide differences of opinion in the various plans submitted. Several plans suggest the selection of the board solely by the stockholders, others by the stockholders and the Federal Government jointly. Again, others would require membership, on the board, of employees, representing the labor organizations.

The predominant view is that the board of directors should be selected by the stockholders and the Government jointly, and this plan will probably meet the public need of close Government supervision. If the Government representatives are chosen from among able business men throughout the country, and not by political preferment, it will result in strong business administration of the railways. The Government members should also be represented on the executive and finance committees of the boards of directors, and compulsory attendance at meetings of the board and the committees should be provided. The selection of such a board would safeguard the interests of the owners and the public and should meet with public approval.

Operation—Private operation is recommended by nearly all the plans as conducive to the best and most efficient service and economical results. The public has had a demonstration of Government operation during the present Federal control of the railways, and doubtless the conclusions reached are the results of this experience. Due consideration must, however, be given to the conditions surrounding Government operation during Federal control. The public was quite willing to endure the inconvenience and increased cost, with less efficient service, during war times, as a contribution toward the winning of the war, the paramount consideration, but it is not prepared to yield to permanent Government operation. Private operation produces results through individual initiative and incentive, which, it has been demonstrated, are lacking in Government operations.

Consolidations and Interest Guarantees

Consolidations—The consolidation or merger of the present railway systems is subject to a wide diversity of opinion in the various plans, and range all the way from a single unified system to regional systems composed of a varying number of lines. The present laws do not permit the consolidation or merger of parallel and competing lines. Therefore, it will be necessary to pass enabling legislation to perfect a comprehensive railway plan. Competition must be maintained between all important traffic centers to give the public the best service, and consolidation should not be carried to the extent of destroying this necessary competition.

The prevailing view is that the country should be divided into regions, and that within the respective regions there should be consolidation of systems, but not to such an extent as will fail to maintain competition between all important traffic centers. The plan which seems to meet the situation in the most practical manner divides the country into eight regions. In these regions, the present systems are to be consolidated into regional systems, with not less than two principal competing systems, reaching all important points, in any one region, thus preserving competitive service. This plan contemplates 17 regional systems, the nuclei of which would be the strongest lines now existing in these regions. The average mileage of the regional systems would be about 15,000, which is not excessive for efficient operation as one unit.

A careful analysis of this plan shows that such a consolidation could be accomplished with minimum disturbance to the existing systems. The 17 nuclear systems would embrace the majority of the so-called strong systems, leaving only the remainder, which form a comparatively small mileage, to be allocated to the nuclear lines. These remaining lines generally have, under the intense competition prevailing for years, operated under most adverse conditions and with uncertain results. The plan proposed would adequately provide for the future of these lines, with better service to the public and more certain financial return to the owners. It will take care of the so-called "weaker lines" and will place them beyond the financial failure and reorganization which have been their experience.

Result Will Be Financially Strong System

The strong lines are always able to provide for their needs, and if the weaker lines are protected the result will be a financially strong transportation system which will be able to serve the public with equal efficiency in all parts of the country. The community located on a "weaker line" is entitled to good service as much as that now served by the stronger roads, and under this plan the weaker lines would be a part of the stronger lines.

The plan as outlined has been developed along practicable and constructive lines and with definiteness, and seems to meet the situation more completely than any other plan respecting this particular feature.

Guarantees—A guarantee of an adequate return to meet the requirements of the railways is recommended in nearly all the plans. Some provide for a guarantee of rates adequate to protect existing investments and attract new capital; others recommend a guarantee of a fixed return upon the capital investment, but leave in doubt the method of determining the investment; others, a minimum fixed return and a division above the minimum between the owners and the Government; one plan provides for a bonus to the employees, by participating in the return.

Whether the country is prepared to guarantee a fixed return upon the capitalization of railways or to establish a level of rates for transportation which will provide a return to meet their financial requirements, the fact remains that unless one or the other means is adopted the transportation industry of the country will languish. Capital will not seek investment in railway securities unless there is some reasonable assurance of an adequate return.

The experience of the past has demonstrated the futility of depending upon a schedule of rates sufficient to meet the needs of the railways, but there is no reason why it would not be entirely practicable so to establish the rates as to meet the situation with equal justice to the public and the security owners.

There are serious objections raised to the Government's guaranteeing a return upon the capitalization of a corporation. If done for the railways, some say, why not for other industries? Others predict that such a policy would lead ultimately to Government ownership. Some have proposed that the Government

guarantee the interest upon the bonded indebtedness of the railway corporations, at the same time fixing a level of rates which will afford an adequate return upon the stock. This plan would at least protect the underlying securities and prevent embarrassment through default and receivership.

The determination of the amount of the capitalization of the railways can only be reached by a valuation of the respective properties. It will not be possible to await the results of the Federal valuation now being made, as it will be some years before that is completed. The situation demands immediate attention. It is not impossible for a fairly constituted commission of reasonable and competent men to fix this valuation in a comparatively short time.

Whichever plan of guarantee is adopted, it must form the most vital element in the problem, and unless the confidence of the public is restored in the investment in railway securities, capital will seek other channels and our transportation facilities will deteriorate.

The most acceptable plan seems to be one that will safeguard first the funded indebtedness and, second, a minimum return upon the remaining securities based upon a fair valuation to be determined in each case, giving due consideration to any expectancy values which may be found to exist. The Government will not necessarily assume any permanent financial obligation in such a plan, as it will have the power to adjust the rates of transportation so as to provide the necessary revenues.

Financial Structure and Rate Regulation

Financial Structure—The various schemes proposed to provide a new financial structure for the railways are interesting, and are mainly as follows: The new financial structure to be adjusted to such plan of rate regulation or Government guarantee as may be adopted; the consolidation of existing railway systems into a number of Federal regional corporations, which shall issue securities in exchange for existing securities, the new securities to be guaranteed from 4% to 4½% on the bonds and from a minimum of 2½% to 6% maximum on the stock, participating with the Government in excess of 6%; the valuation of railways to be ascertained by a joint commission of the Government, owners and shippers, and exchanging the present securities for new securities on an interest-yielding basis and to be guaranteed, first, interest on bonds, second, 4% on par of preferred stock, the balance of equity to accrue to common stock; the exchange of existing stocks at market value for Government bonds, which, in effect, would be Government ownership as proposed by the labor organizations.

If the owners of railway securities expect to receive a Government guarantee of a fixed return, or a guarantee by a level of rates that will produce the necessary revenue to secure that return, they must and should be willing to place their securities on a basis to which they would be entitled by sound financial rules.

This means, of course, a new financial structure for railway securities, and can be accomplished speedily and equitably, if dealt with fairly and honestly.

Three classes of securities would have to be dealt with: First, bonds or funded debt; it has been proposed that these be exchanged for new securities guaranteed by the Government at 4½% par value. The valuation of the outstanding funded debt can be readily determined and be exchanged strictly upon the basis of their actual worth. This will take care of 55% of the total railway capitalization. The owner of railway bonds could not afford to refuse a fixed income bond, even at somewhat lower interest return, for an existing security subject to the vicissitudes of present railway securities.

Second, preferred shares, which, it has been suggested, be exchanged for new 4 to 4½% securities. The preferred shares of some corporations will be found to have a value equal to or greater than the bonds. Where such values are found to exist, they can be readily dealt with on the same basis as the bonds. Preferred shares falling below the value of bonds can be treated with the common shares. The preferred shares represent 7% of the total railway capitalization.

Third, common shares; it has been suggested that these shares be entitled to the equity remaining in the property after the bonds and preferred shares have been protected. This means a valuation of the property, its earning power over a period of years, and other elements of value which may be ascertained. It would not be a difficult task to arrive at a fair and equitable basis for the exchange of these securities on a rate of return which would safeguard the investment. The common shares represent 38% of the total capitalization.

Necessary provision must also be made for existing equipment trusts, unfunded debts, etc.

It has been proposed that a corporation to be called the Interstate Commerce Corporation be organized under Federal charter to act as a clearing house for the exchange of existing securities of the railways into the new securities of the Federal regional railway systems to be organized, of which the total number for the country would be 17. These regional railway systems would arrange to acquire the securities of the various lines allocated to the nuclear roads now embraced in the larger systems, subject to the approval of the Interstate Commerce Corporation. Any railway corporation not electing to join the regional system would, of course, not be subject to the guarantee.

Would Place Securities on Sound Basis

This plan offers no greater difficulties than are usually encountered in the reorganization of any single railway system and would place railway securities upon a sound financial basis.

Rate Regulation—The courts have recognized the principle that "rates should be reasonable and sufficient to provide an adequate return on the capital invested." The Interstate Commerce Commission and the representatives of the shippers also testified before the Senate committee hearings to this effect. The difficulty lies in determining what is a reasonable rate. The burden of proof has been upon the carriers, and in most cases in the past the commission, under its rules, has suspended advances in rates indefinitely, largely because of the impossibility of proving that the rate was reasonable.

The proper solution of the question of rates is the crux of this whole matter; if the public is not prepared to establish a level of rates that will provide the neces-

sary revenue to enable the railways to exist and expand, the whole structure will fall. The people of this country are enjoying the lowest freight rate of any nation on earth—one-third that of England—and the difference between the rates necessary to enable the railways to prosper and those that are inadequate is so slight as to be almost imperceptible to the average person. It has been proposed that regional rate commissions, with proper representation of shippers, the Government and the railways, be created to deal with this question, their duty being to determine definitely the adjustment of rates necessary in any region to produce the required revenues. The final authority in rate matters would be the Federal Railway Board or the Interstate Commerce Commission as reconstituted. The question of intrastate rates now regulated by state commissions would be subject to such restrictions as to prevent discrimination against interstate rates.

The public is willing to pay rates that will provide good service, and the regional rate commissions, with all the facts before them, could readily determine what these rates should be.

Pooling—The pooling of traffic among railways under existing laws is prohibited. During operation under Federal control this restriction has been disregarded, and traffic has been routed with respect to the shortest and most available lines. This has resulted in economy of operation and has been one of the beneficial effects of Federal control. This advantage should be retained by the railways when they are returned to private operation. With a guarantee as to income, it will be immaterial to the railways whether traffic is handled by the shortest or longest route, but the public is interested in having all traffic handled as economically as possible, in order to reduce the rates to a minimum. Legislation should be provided to enable the railways to continue the benefits from pooling of traffic. On the other hand, if the plan of a limited number of regional railways is adopted, the pooling of traffic will be largely effected through the consolidation of the various lines.

Equal in importance to pooling traffic is the common use of facilities, such as terminals, trackage and equipment, which has also been one of the beneficial features of Federal control. If continued under private operation, it will result in economy and prevent the waste of capital in duplicate facilities which obtained under private operation. This can be accomplished only by a Federal control board or agency vested with jurisdiction over such matters. It cannot be and never has been done voluntarily under private control, and the public is entitled, in better service and reduced rates, to the benefits accruing from such a practice.

Labor—The labor organizations have proposed that the Government shall own the railways and operate them in one unified system, labor to reap the benefit of such operation. The defects in this plan are that it ignores the interests of the owners and the public, two vitally interested parties.

Labor is indispensable in any industry, and is entitled to its full reward; so also is the capital which is invested in the railways. Much of the capital now invested was earned by the labor of those who have been provident and put their hard-earned savings into railway securities. These investors are equally entitled to consideration. The public also, which finally pays the bills, earns its money largely by labor and deserves consideration.

Labor on railways is enjoying a higher return today than in any other industry; it should be protected in its wages and working conditions, both of which should be fair and reasonable, just as the rates should be.

The methods of dealing with railway labor organizations in effect under previous private control should be changed and regional labor commissions appointed to deal with all questions of rates of pay and rules and regulations of employment. Their findings and recommendations should be subject to the same authority as finally passes upon the rates which fix the revenue of the carriers.

Conclusions—The eleven points considered above comprise the essential and fundamental elements of the railway problem that is now demanding a solution by Congress.

Congress can solve this problem wisely and constructively and with equal justice to all, provided the various interests coöperate with Congress and approach the subject in a spirit of compromise.

Acceleration of Concrete Hardening

AS THE result of some experiments made by the Bureau of Standards to develop a method to accelerate the rate at which concrete increases in strength with age, it was found that the addition of small quantities of calcium chloride to the mixing water gave the most effective results. A comprehensive series of tests was inaugurated to determine further the amount of acceleration in the strength of concrete obtained in this manner, and to study the effect of such additions on the durability of concrete and the effect of the addition of this salt on the liability to corrosion of iron or steel embedded in mortar or concrete.

The results to date indicate that in concrete at the age of two or three days the addition of calcium chloride up to 10% by weight of water to the mixing water results in an increase in strength, over similar concrete gaged with plain water, of from 30 to 100 per cent., the best results being obtained when the gaging water contains from 4 to 6 per cent. of calcium chloride.

Compressive strength tests of concretes gaged with water containing up to 10% calcium chloride, at the age of one year, give no indication that the addition of this salt has had deleterious effect on the durability of the concrete.

Corrosion tests that have been completed indicate that the presence of calcium chloride, although the amount used is relatively small, in mortar slabs exposed to the weather, causes appreciable corrosion of the metal within a year. This appears to indicate that calcium chloride should not be used in stuccos, and warns against the unrestricted use of this salt in reinforced concrete exposed to weather or water.

The abstract of the results of the tests appear in the recently issued annual report of the Bureau of Standards.

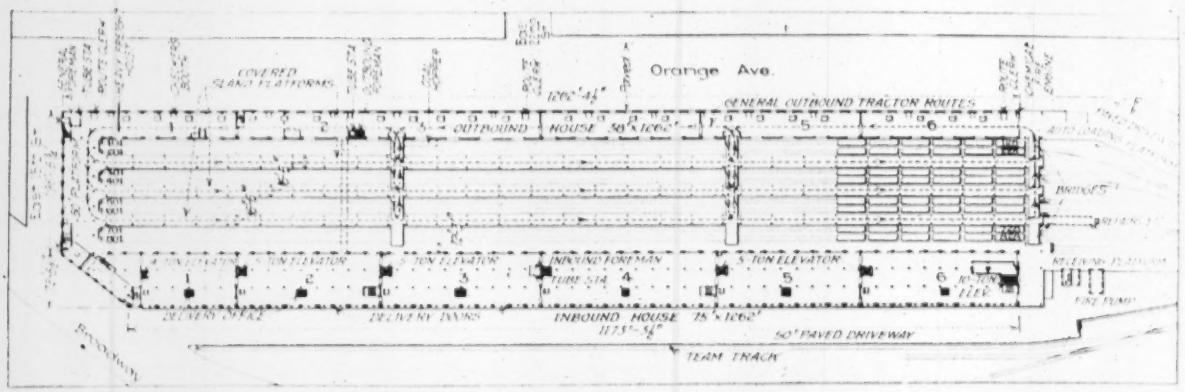
Operation of New York Central's Cleveland Freight Terminal

Mechanical Handling Developed to High Degree of Efficiency—Use of Tractors, Trailers, Lift-Truck Platforms and Hoists

By W. E. Phelps

Assistant Engineer, Office of Consulting Engineer, New York Central Railroad, Cleveland

SINCE the opening early in 1918 of the New York Central Railroad's big new Orange Ave. freight terminal at Cleveland (described in *Engineering News-Record* of Mar. 14, 1918, p. 495), the railroad has met the constantly increasing shortage of labor, both unskilled truckers and experienced gang foremen, by the use of an unusual amount of mechanical equipment, and by the constant development, through experience, of highly efficient methods of freight handling. The freight is moved on four-wheel trailers and special equipment drawn in trains by electric storage-battery tractors, and a large part of the inbound freight is held, awaiting delivery, on portable platforms picked up and transported by lift trucks. Special telephone equipment facilitates intercommunication, and pneumatic tubes transmit bills and papers quickly, while the administrative systems that are employed minimize lost motion for both the patron and the railroad.



PLAN SHOWING CONNECTIONS BETWEEN INBOUND AND OUTBOUND FREIGHT HOUSES, CLEVELAND TERMINAL

There are two separate freight houses, each 1262 ft. long, as described in the previous article, with island platforms and trucking bridges as illustrated in the plan reproduced herewith. The double-leaf hand-operated bascule wooden trucking bridges divide each track into three operating sections of nine, ten and nine cars capacity, respectively. The tracks are at street level, with the floors of houses and platforms at the height of the car and the auto truck floors. The basement and upper stories possess no feature that is special, from an operating point of view, and only the operations on the main floor will be described.

Car "spots" are numbered systematically. The first figure of the number denotes the track, and the last two figures the position on the track—as, for instance, 601 to 628 for the 28 cars on track 6. Signboards bearing the numbers are permanently posted opposite the respective positions, and cars are known in the house operations by their "spot" number. Perfectly "green" truckers digest this system of car number layout in a few minutes.

The platforms are well lighted artificially, and plug boxes for extension cords are placed at each car for use when needed; on each platform at each bridge is displayed a prominent yellow marker light to indicate to employees the location of the nearest bridge; blue lights throughout indicate fire-protection equipment; certain circuits control every fifth light on the platforms to provide switching crews and watchmen with some light for night work; the bascule bridges are automatically signalled with red and green lights.

Freight handling here naturally divides itself into the two classifications of (1) outbound freight received for shipment; and (2) inbound freight shipped in for local delivery, each of which will be treated separately, as they differ materially. There is also a small amount of transfer freight handled from inbound cars to outbound cars for forwarding.

The house operating force comprises a general foreman reporting to the agent, and a foreman for each house, each with assistant foremen and clerks, with route clerks, checkers, loaders, trainmen, freight handlers, stowers, etc., handling outbound freight, and deliverymen, tallymen, pilers, callers, freight handlers, etc., handling inbound freight.

A driver with outbound freight goes first with his shipping bills to any one of three route clerks, located in special booths at the ends and center of the houses. These clerks are experts, and are supplied with all necessary routing information; they mark the shipping bills with the spot numbers of the cars into which the freight is to go, and these numbers govern the checkers in their handling of the freight; this obviates the necessity for each checker or receiving clerk routing the freight he receives (the practice at many houses), and eliminates many errors common with that system.

The spot numbers on the bills also indicate roughly to the teamster the door to which the freight should be taken, as the 56 driveway doors are numbered in groups from 1 to 28, to correspond with the car numbers. The checkers also advise teamsters where to take certain shipments, and compliance with such requests, though not strictly enforced, is fairly general and gradually improving, and results advantageously in shorter trucking hauls and greater consolidation of trailer loads for given cars.

The checker and gang receiving freight loads it generally direct from the wagon onto four-wheeled trailers (loaded for only one car—no "peddling" of freight is permitted), chalks on it the spot number already pencilled on the bills by a route clerk, weighs it on an automatic dial scale adjacent to the doorway, and shoves it out toward the main aisle, where the "despatcher" or "hooker" (one for each of the six sections) shifts the trailers around by hand into trains of six to ten or more, made up if possible with the loads at hand, for one section of one platform, and so grouped that as the tractor-drawn train proceeds the rear trailers are cut off progressively at the proper cars, and when all loaded trailers have been cut off the tractor picks up empties to take back into the house.

The train movement is westwardly in the house and eastwardly on the platforms; this single direction of movement is advantageous in many ways.

In the tractor-train operation it has proved economical to provide, in addition to the motorman, a "brakeman" to couple and uncouple, watch the train to prevent freight falling, etc., thus measurably speeding up the entire operation. Formerly, a gang of three stowers was assigned to each eight cars on the platform to handle the loading of cars, but this method has been superseded by the system, which works much better, of putting all the stowers on one platform in one gang, under the supervision of a head stower, who can intelligently direct the efforts of all the men to prevent

LOADED LIFT TRUCK PLATFORM AND EMPTY TRAILERS

congestion on the platforms, and is responsible for the proper loading of the cars.

The telephone installation by which the head stowers can promptly notify the foreman's office of "full cars," and the foreman's office in turn notifies all route clerks and checkers of the condition, with consequent diversions to other available cars, saves considerable backhauling of freight which would otherwise be marked for cars which would be found full when the freight reached them. This condition naturally occurs just at the peak-load time in the late afternoon, and is a fruitful source of confusion and wrong loading.

A pneumatic tube system for the handling of bills between the "checkers" and the billing department results in a uniform flow of bills into the billing office all day long, permits very prompt billing and reduces the delay in getting out bills for cars after the house is closed; this permits prompter dispatch of outbound trains.

HOIST FOR HANDLING MACHINE TOOLS, SHAFTING AND OTHER HEAVY FREIGHT

Checkers do not "shoot" their bills until the tractor has taken the freight off the floor.

The "sailing date" plan is in effect in Cleveland, and to meet this condition, with its prescribed daily change of "regular" cars which would seriously affect a "permanent set-up," a modified set-up is used, in which certain grouped spot numbers are assigned permanently to each group, consisting of cars to be set out at one certain main station or yard, with the groups arranged to meet the road operating requirements, but the arrangement within each group entirely flexible and at the option of the house forces, who may arrange it at will to meet the varying exigencies of the business.

Trains, under this arrangement, are made ready for road movement by pulling whole tracks at a time and simply kicking out the "set-backs" and switching any outbound team track cars into the groups. The westbound train, given the preference, leaves about 45 min. after the cars are sealed, the eastbound train leaving soon after. In resetting the house with empties after the outbound freight leaves, set-backs are switched back only into their proper groups, and not onto a designated "spot."

Due to the exceptionally heavy class of freight handled, consisting largely of manufactured metal goods, paints, oils, etc., the trailer loads are believed to average heavier than at any other house in the country. A week's check recently showed an average load of 1329 lb. per trailer per trip, each trailer in service averaging about six trips per day, while figures obtained from other stations have indicated an average trailer loading of 1000 lb. to 1100 lb. per trip.

The trailers used are of reinforced wooden construction, with 36 x 72-in. platforms 20 in. above the floor, with inverted U-shape removable "gates" of 1-in. pipe fitting into numerous stake pockets at sides and ends, and interchangeable on the different makes of trailers used. The main wheels are roller-bearing, of 18-in.

diameter and with 4-in. face, and the ball-bearing casters have 9-in. plain bearing wheels. These wheel sizes were selected after the undoubted merits of lower wheels as effecting easier loading conditions had been carefully considered, because of the greater difficulty of moving low-wheel trailers by hand to switch them into trains, move them into cars, etc., and the choice seems to be justified by results, as even the 18-in. wheel trailers are difficult to push around when unusually heavily loaded.

But there is some freight, notably oil and paint in barrels, which is hard to handle on and off trailers with 20-in. platforms, and for handling this class of goods

TRACTOR AND TRAILERS ON TRANSVERSE TRUCKING BRIDGE

an all-steel underslung trailer with the same wheel sizes, but with platform only 8¾ in. above the floor, is provided. A number of old two-wheel hand trucks have been converted into very serviceable trailers for barrel freight by substituting heavy double 5½-in. casters for the original rests or "feet," and equipping them with necessary chains and eye-bolts for couplers. Otherwise, the use of two-wheel trucks in handling outbound freight has been practically eliminated. The couplers on the standard trailers consist of a hook on the caster end, fitting into an eye on the main-wheel end of the trailer ahead.

Many types of dollies and similar special equipment, some of which are illustrated, are in use to handle the large number of heavy machines, etc., received; experiments are being made toward further development of equipment, for handling these heavy loads, which, among other things, will give better load distribution on the floors.

Short sections of gravity-roll carriers, mounted in frames with casters to bring one end to trailer-floor height, while the other end is placed on a discharging wagon or truck, to assist in a quick and easy transfer from wagon to trailers, are under order and are expected to help with certain classes of freight.

A hoist has been provided to handle economically heavy freight like machine tools, etc., from auto or wagon to trailers or dollies. This consists of a suspended I-beam runaway extending out about 8 ft. over the driveway, and back 16 ft. into the house, with two three-ton geared trolley hoists operating independently of each other, giving a combined capacity of six tons, which can be concentrated or applied at different points on a load, as necessary; this has a clearance of 10 ft. from the floor to the hook in highest position.

Three-wheel tractors, with 30 cells of Edison A-6 battery, developing approximately 450-lb. drawbar pull, and, with a load of three or four tons, capable of a speed of five or six miles per hour, are used. Loads higher than 11 tons, including weight of trailer, are sometimes pulled, but with material reduction in speed. One load of 25 tons gross, with 21 trailers, was recently pulled 600 ft. and around two 90° turns; however, "freak" loads like this are frowned upon. This three-wheel type has a very small turning radius, and is surprisingly facile in operation. Batteries are charged at night through a motor-generator charging set, and are boosted at noon to stimulate them for the afternoon.

Inbound freight requires quite different handling, and the peculiarities of the plant have made possible more or less radical departures from usual practices. The 1262-ft. house is divided by firewalls into six sections, each in charge of a delivery foreman, under whom are two pilers and a clerk. Sections 1 to 4 are allotted to freight for firms whose business is regularly large enough to justify assignment of regular space in the house; such spaces are permanently marked by appropriate signboards. The "alphabet" sections, 5 and 6, handle freight for smaller and miscellaneous consignees. Freight for any given shipper thus goes to one designated spot in the house.

Inbound freight arrives in cars containing many and various shipments, consequently it is impracticable to place them in the house for unloading in any predetermined order to facilitate their unloading; and, as a result, the hauls on individual shipments to designated locations in the house are often long, sometimes the full length of the plant; under these conditions hand trucking proved expensive, and tractors and trailers have been substituted with markedly good results.

Trailers are loaded to capacity at the cars, with freight for one consignee if possible, otherwise with freight for one section. They are put in trains and pulled into the house by tractors and dropped off in the main aisle nearest the proper pile for unloading. All main and cross aisles in the house are plainly marked with painted 4-in. white lines, frequently renewed.

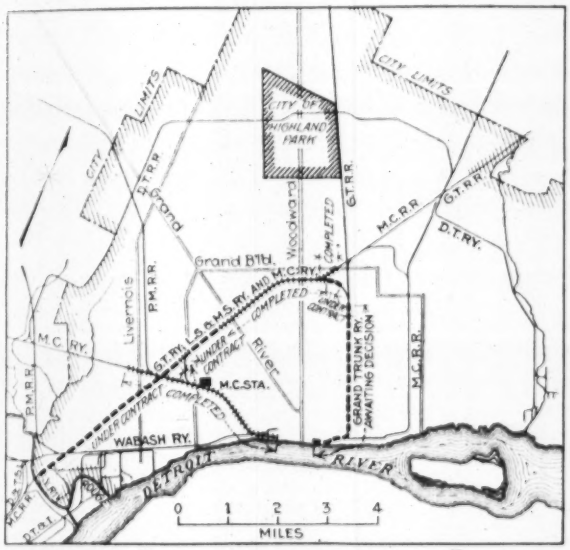
When the size of a shipment, or those of several shipments for one consignee, justify it, the freight is unloaded from the trailers directly onto a 42 x 60-in. lift-truck platform (of which there are about 60 in each section); otherwise, it is unloaded directly on the floor. These platforms are sturdily built, with stake pockets for use when needed, and a large proportion of the inbound freight is handled on them. They permit quick delivery of large loads of freight without second handling, saving labor and damage, and are enthusiastically indorsed by the operating forces. They also add to the general neatness of the house, and prevent freight from getting lost. One lift truck with 9-in. wheels, 2½-in. lift and 48-in. frame is used in each section. These trucks and platforms are used practically only for delivery of freight as above and for occasional transfer of freight to storage, etc.

Transfer of freight by trap-car from this plant to city stations of other roads for forwarding has been abandoned, and this transferring is now done by truck. Fire drills are carried out regularly by the house forces, organized into regular fire companies under the direction of a fire warden. Car-repair facilities permit light repairs and testing and cleaning of brake valves as the cars stand at the platforms, also the charging of train lines before the house is closed, thus saving time after the train is switched up ready for the road.

Detroit Plans Comprehensive Scheme For Grade Crossing Removal

City Engineers Study Problem as a Whole and Recommend Program for Next Fifteen Years — Prepare Standards of Design and Study City Planning, Freight Yards and Industry Tracks

GRADE crossing elimination at Detroit, Mich., is viewed as a single problem by a city engineering commission which has just reported. The needs of the city for the next 15 years have been carefully studied, and a progressive program has been laid out for the completion of all the necessary work in that time. Other important factors of the problem discussed are the relative advantages of full and partial elevation, the clearance and design of subways, the relation to industry facilities, the relation to streets in outlying districts of the present and future, the city-planning aspect and the apportionment of cost.



PLANS FOR GRADE CROSSING ELIMINATION AT DETROIT INCLUDE ENTIRE CITY

The report was made by the city's Division of Grade Separation and Bridges, under the direction of the Department of Public Works. This division was established in January, 1917, with John W. Reid as engineer in charge and Prof. Henry E. Riggs, of the University of Michigan, as consulting engineer. Its report was submitted in September to Clarence W. Hubbell, city engineer, and passed with his approval to H. H. Esselstyn, commissioner of public works, who in turn transmitted it to the city council. It was referred to the council committee on grade separation and it is expected that early action will be taken by the new council.

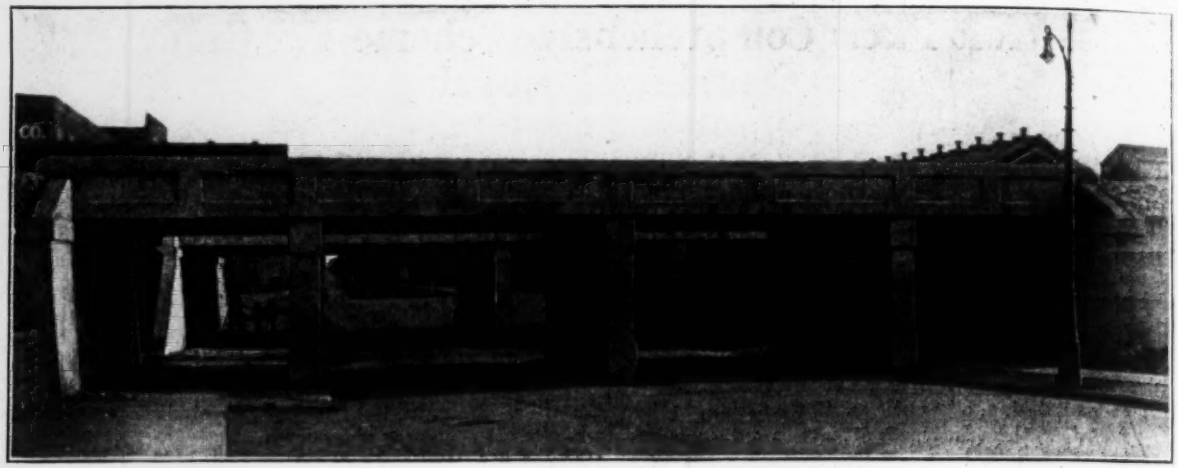
Modern grade-crossing elimination in Detroit dates from 1900, and in 1903 an agreement was made by which the annual expenditure was to be not over $200,000. This was amended slightly in 1906, and additional agreements were made up to 1917. Work which was to have been commenced by the New York Central Railroad and the Wabash Railroad in 1917 was deferred owing to war conditions, by permission of the city council. Since 1900 there have been 43 grade crossings eliminated.

Present conditions are as follows: On 64½ miles of line, considering parallel railways as one line, there are 289 street crossings, at 58 of which the grades are separated, 43 having the tracks carried over and 15 having them under the streets, while 20 more crossings are covered by existing contracts. There remain 211 grade crossings on main lines and 34 on industrial spurs, while 37 of the former carry street-car tracks. Counts made at 147 crossings in 1917 showed an average traffic of 1011 street vehicles and 41 train movements per crossing per day. Street-car movements over crossings were about 250,000 for the year, or probably more than 1,000,000 movements over tracks. Grade separation demands attention urgently as a part of the city's traffic problem. It appears that with the growth of the city the increase in number of grade crossings has been greater than the decrease by grade separation.

Early completion of plans for a comprehensive scheme of eliminating grade crossings, together with a definite program of construction, is recommended by the report. No such program has been prepared, as yet, but the railway system of the city has been divided into sections which may be handled successively. Determination of the grades of streets and railways will permit the making of provision for these ultimate grades in the design and construction of new buildings and industries. With a complete scheme for the entire city the streets of heaviest traffic may be handled first and work carried on at different points and on different properties at the same time, so that no railway will be unduly burdened in any one year.

A program of work must take into account the fact that as it progresses the city will increase in population and area, and that there will be an increase in miles of railway and number of streets. Such a program, it is explained, would cover all railways within the city limits, all existing crossings and all additional crossings which may be necessary to furnish traffic connections with new industrial or residential sections of the city.

The cost of work to be provided for by a comprehensive plan is estimated at from $30,000,000 to $50,000,000. For the completion of such work by 1935 or 1940 the annual expenditure must be very much larger than the limit of $200,000 provided in existing contracts with the railways. To carry out the program it is recommended that the contracts should fix an annual amount, increasing with each year, so as to place the heavier share of the burden on the later years of the period. It is suggested that $2,000,000 for the first year is the minimum to be considered in view of the work urgently needed, and that this should increase about $200,000 per year until it reaches $4,000,000 in 11 or 12 years.



CONCRETE SUBWAY ON DETROIT TRACK ELEVATION; SECOND AVENUE AT NEW YORK CENTRAL LINES AND GRAND TRUNK RAILWAY

Street 80 feet wide has two 21-foot roadways, 13-foot headway and 3—18 per cent. grades

Elevation of tracks as the main principle, in combination with depression of streets as a secondary consideration, is the method advocated in the report. All the work done so far at Detroit has been based on the compromise system of elevating tracks from 6 to 10 ft. and lowering streets from 6 to 14 ft., the comparatively slight elevation being due largely to the fear of owners of industries that a greater elevation would harm them seriously. Another reason, probably, was the belief that greater elevation would lead to excessive cost, but the report states that the total cost is no more for 15 to 17 ft. than for 6 to 8 ft. elevation. Adjustment of tracks in industrial plants may be more expensive, but can usually be made without difficulty, and in close quarters the loading and unloading may be handled at platforms on the second-floor level.

Public interest must dominate in fixing grades of the main traffic streets, since this interest is so overwhelmingly large. For these reasons the following recommendations are made in the report: On all main arteries the maximum street depression should not exceed 2 to 3 ft., with approach grades not exceeding 2½%; on other important streets the maximum street depression should be 5 ft. and grades 3%; in purely industrial districts, especially where the streets carry little through traffic, considerably greater depression may be permitted, but in no case should the grades exceed 3½ to 4 per cent.

Track elevation is shown to be the logical method of eliminating grade crossings at Detroit, since the flat topography, as at Chicago, would prohibit depression on some lines, while complications from sewers and water mains would either prevent it or make it expensive on most lines. For clearance at subways 14 ft. has been adopted in the past at Detroit, but 15 ft. is provided for on some work, and this figure is recommended for streets that have or are likely to have street-railway line. For streets without car lines a clearance of 13 or 14 ft. is considered ample.

Track depression is recommended, however, for that part of the Grand Trunk Railroad on De Quindre St. from Jefferson Ave. to Hale St., 1.3 miles, beyond which there would be track elevation to Clay Ave., two miles. It is explained that this case is exceptional. While the tracks are now on the street level they already pass under three important streets, no large industries are served and there are no complications due to sewers or other underground utilities, as the road was built some 60 years ago. The railway has proposed elevation of its tracks for the entire distance and has submitted two projects, but the report considers one of these open to strong objections, and both of them inferior to track depression on the first section of the line, so far as public interest is concerned. This matter is now awaiting the decision of the Michigan State Railway Commission.

Taking up the design of subways, the report advocates concrete structures, properly waterproofed and having ballasted floors, and the flat-slab type is preferred to arch designs. It is pointed out that extra expense for appearance should be avoided in view of the great total cost and the large number of structures, although some expenditure for this purpose may be warranted at structures crossing boulevards and main thoroughfares. It is recommended that no intermediate supports be permitted in streets of widths up to 50 ft. Where the width is greater or the crossing is at an angle, supports at the curb lines may be necessary to avoid excessive height of elevation, but a support in the middle of the street should not be considered when the width between curbs is less than 60 ft. Shorter spans may be permissible for driveways and streets serving industries only.

An adequate city plan of streets and roads should be made in advance of agreements for grade-separation work, and the report suggests that the city plan commission should coöperate in this respect. Proposed changes in streets should be considered in their relation to grade-crossing elimination, and it is recommended that in general long through streets should be maintained at full width. Opening of new streets and widening of existing streets should be considered as part of the grade-separation project when traffic can be improved in such ways. Closing of streets, it is suggested,

should be considered only in order to improve a subway approach or where the streets are very short or very near the river, where traffic will always be limited. In industrial districts, however, the closing or changing of streets may be of benefit to the railways, the city and the industries.

Location of large railway yards in the outlying districts is a special condition noted, as in some of these cases opened streets are several thousand feet apart, and subsequent plotting of lands adjacent to the right-of-way has been made without reference to the possible opening of streets across the railway. The report urges a careful study of railway right-of-way within the city limits, and the location of a sufficient number of cross streets connecting with main thoroughfares. These should be of ample width, 66 ft. country roads being opened at least across the right-of-way for future avenues of 80 to 100 ft. width. Plans for grade separation on these outlying thoroughfares, it is pointed out, should not be made without full consideration of their future effect upon the city.

The effect of grade separation on industries is discussed as an important consideration. At 880 industries there are 1600 private sidings with a capacity of 15,635 cars, while 159 industries which are located on the railways use team tracks instead of private sidings.

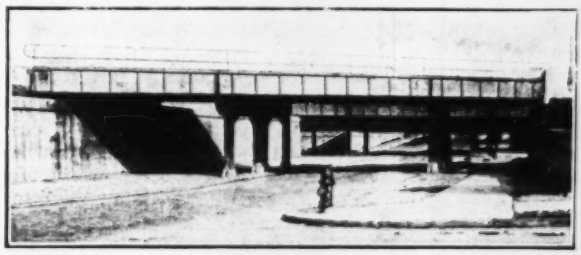
Some industries—large and small—will not be affected seriously, while others will be subjected to considerable trouble and expense. In general, however, track elevation to approximately full height is the cheapest method for the railroad and also brings the tracks near to second-story factory levels, so as to involve less change and reconstruction and to give better spur track grades than an elevation of only 6 to 8 ft. Furthermore, many industries such as coal yards and warehouses can handle a larger volume of business with tracks at the higher level.

Relative Cost and Its Apportionment

Cost of track elevation, says the report, is largely in grading and masonry, and in carrying traffic during construction. For a railway fill made by trains, the cost of steam-shovel loading, train haul and unloading will average less than half the cost per cubic yard of removing the clay soil in Detroit streets, hauling it by wagon to scows and then dumping. Masonry walls for such a fill are of uniform height and standard section, while street retaining walls having approximately 10% more material are irregular in height and section and consequently of greater cost per cubic yard. The cost of permanent bridges and that of carrying railway traffic during construction are substantially the same in either case, while the cost of carrying street traffic during construction is said to be less with railway elevation than with street depression. The cost of track construction and readjustment of industry tracks for elevation is considered to be more than offset in track depression by the cost of rebuilding sewers, water mains, paving, sidewalks and street-railway tracks, in addition to the property damages.

Full elevation of the railway, without change of street grades, is the cheaper solution of the problem, according to the study made at Detroit. The report states that this holds fairly true for all railway right-of-way of 60 to 100 ft. width, with eight or nine streets per mile. It will not hold true, however, where there are only a few streets per mile and where the railways have large yards, nor where the elevation of the railroad involves that of a large mileage of industrial spur tracks or extensive rearrangement of numerous factory buildings.

The apportionment of the cost of grade separation at Detroit has been usually on the basis that the railways



STEEL SUBWAY ON DETROIT TRACK ELEVATION: WABASH AVENUE AT NEW YORK CENTRAL LINES AND GRAND TRUNK RAILWAY

Street 65 feet wide has 26-foot roadway, 13-foot headway and three per cent. grades

have paid the entire cost of construction on their land and on the streets, while the city has paid all property damages, and the street railway has paid for all temporary work needed to maintain its traffic and for all new track and overhead equipment. No adequate or uniform records of cost have been kept, but it is generally understood that the city's share has been 20 to 25% of the total cost. The report considers it probable that with greater elevation of tracks the cost of property damages will be reduced, thus decreasing the city's share of the total. It is considered reasonable, however, that the city should pay from 20 to 25% of the cost of a well designed public improvement and should assume the entire maintenance of the streets. On the other hand, the report points out, the new city charter appears to contemplate payment of nothing more than property damages, so that any plan imposing upon the city a definite percentage of cost probably would have to be passed upon by the courts. As to street railways, the report considers that the company should build its own tracks and pay more than its past share of 2 to 3% of the total cost. Municipal utilities should pay for changing their underground properties to conform to the street changes.

Road Funds Available in Wisconsin

For construction and maintenance on the Wisconsin trunk-highway system and the county systems of prospective state highways, about $11,000,000 will be available for 1919, according to the estimate of A. R. Hirst, state highway engineer. This includes $3,800,000 for state-aid construction, $3,200,000 for Federal-aid construction, $1,500,000 for county construction and $2,500,000 for state and county maintenance work. In addition, the towns will spend about $3,000,000 on township roads.

Governors' and Mayors' Reconstruction Conference Fails to Get Action

Officials at Meeting in Washington Do More Listening Than Talking and Adopt Prepared Resolutions, but Recommend No Comprehensive Program

(Editorial Correspondence)

TWENTY GOVERNORS, 135 mayors, and the representatives of many more executives, met at the White House last week at the invitation of the President to discuss the problems of unemployment and business resumption. They listened to many set addresses by Federal officials, told one another generally of the conditions in their home communities, received a vague program of action from the representative of the Department of Labor, passed reluctantly a wordy and innocuous document prepared for them by a committee on resolutions, and broke up in disorder with an evident feeling of the futility of the conference. Possibly some of the delegates got a thought or two from the discussions which they may put to use when they get home, but no definite, beneficial suggestions materialized on the floor.

The conference was called by the President at the request of the Department of Labor, and was apparently planned and directed entirely by that department. In the light of the proceedings of the three days, it is now very apparent that there was too much direction. A full program was laid out, made up of addresses by men of such national distinction as to make it impossible for the floor to do other than to hear them. These gentlemen all delivered inspiring and stirring addresses, but it soon was evident that the Governors possibly, and the mayors certainly, had come to Washington not to listen but to talk, and the program did not permit such talk. As an ending to the conference, the mayors got together in a more or less informal organization for future meetings, in the hope of establishing something similar to the present House of Governors.

What the Meeting Was For

According to the President's own announcement, the meeting was "to discuss the proper method of restoring all the labor conditions of the country to a normal basis as soon as possible and to effect any such fresh allocations of labor and endeavor as the circumstances may make necessary." This was the extent of the President's reference to the conference itself. His mind, as evidenced in all of his addresses in this country during his brief stay, was on the matters of international relations, which he soon reached in his speech to the conference. He was followed by Secretary of Labor Wilson, who in a remarkable address clearly indicated the serious possibilities in the labor situation in this country and the decided necessity for immediate resumption of business. Then, after brief addresses by the Secretaries of War and the Navy, the Governors of the various states were called on alphabetically. Here the conference met a surprise, because, with only two exceptions, every Governor arose and stated that there were no labor or industrial troubles in his state. Arizona admitted some difficulties in the copper-mining districts and West Virginia in the coal-mining.

The best part of two sessions was taken up by the Governors' speeches, some of which were direct and to the point. Confidence in conditions, however, was soon shattered when the mayors were given the floor. Unfortunately, the program was so full that only a few of the mayors could be heard. Those who did speak, however, definitely stated that the Governors did not know what they were talking about, that labor and industrial conditions were bad, and that there was no immediate indication of relief.

Through all of the reports there was no sign of any great revival of public work. Here and there an executive announced that his state or city was going ahead with a certain amount of work, in general very much less than normal, but many of them repeated the same statement; that is, that so long as material prices kept up not even a public body could be expected to engage in work. Several of them, Governor Cox of Ohio in particular, definitely demanded that the water be squeezed out of present material prices.

The Plan of the Labor Department

Meantime, a representative of the Department of Labor announced what he called not the plan, but the suggestion, of the department as to a program of reconstruction. He laid down seven items in this program: First, begin all public work, especially public buildings and schoolhouses; second, get behind the Build-a-Home movement; third, get the state to build its full quota of Federal roads on the fifty-fifty basis and appropriate large sums for state roads; fourth, see that traction properties of the state and city receive fair treatment; fifth, urge labor to give a greater service for its wage; sixth, get the state councils of defense to advertise as much now to get people to buy as they advertised during the war to get people to economize; and seventh, help the cabinet officers in their efforts to extend opportunities and provide not only employment but a strong United States Employment Service.

Following more addresses, one on building by a representative of the construction industries and one on roads by a representative of the highway industries, and one by Secretary Lane on his various reconstruction policies, the Resolutions Committee, composed of Governor Cox of Ohio, as chairman, and Governors Sproul of Pennsylvania, Bilbo of Mississippi, and G. F. Peabody, representing Governor Smith of New York, together with Mayor Peters of Boston and Mayor Baker of Portland, Ore., brought in the report of the committee on resolutions. Contrary to the expectations of most of those in attendance who had hoped for a series of definite resolutions which could be voted upon one by one, this document was a well prepared essay of the type common to party platforms, and was so tied together as to make it impossible of paragraph acceptance. It was read with considerable oratorical effect by Governor Cox, and was accepted, after a great deal of opposition, by a two to one vote of those present. Only one clause

was added, recommending to the states that they consider means of releasing natural resources from controllers who, for the purpose of speculation, are holding them. There was also a squabble over the public utilities clause noted below, but that was finally adopted by another two to one vote.

Abstract of the Resolutions

The committee's report, which was supposed to embody the findings of the conference, starts with well-rounded phrases, such as, "We are living in the most thrilling time in all history," "We must progress from the fundamental base of American ideals," "The principles of government must change through the evolutions and processes of calm human intelligence," etc., etc. It has clauses condemning any doctrine which inveighs against both God and government. While admitting that it was not the purpose of the conference to discuss the underlying principles of the question of government ownership, it recommends that the national Government in its present conduct of the railways should continue in the purchase of rolling stock, making added betterments, etc., so as to guarantee at least that much of the purchasing of material which should be started at once. It recommends that the Government make a careful analysis of all economic elements underlying costs, and that it establish a fair price for materials, which price is to be followed by the Government itself, with the idea that if the Government in fairness to all interests concerned approves price schedules on materials, public opinion will accomplish the rest in the needed reduction of prices. Indeed, the one definite part in the resolution is, "Prices must change. There may be an economic justification for some schedules but not many, and if the Government through the operation of a committee or commission such as we have suggested will invite industry to go forward in the work before us, revealing facts and figures upon which earnest calculation can be made, it can, then, in any given line announce to the public what prices it finds to be fair and equitable."

The resolution then definitely recommends that freight rates on all road material, possibly on all building material, be radically reduced. It recommends that there be no present anticipation of an adjustment in the wage scale. It recommends "that the Federal Government continue its helpful offices, with the view to averting serious consequences in the financial affairs of public utilities." It urges that the informal contract act be put in effect as soon as possible and that announcement be made equally soon as to the disposal of Government surplus materials. It regards the discontinuance of Federal aid and maintenance of public employment agencies as both untimely and harmful, and, finally, urges a change in the method of military demobilization by which the soldiers are turned loose in the vast districts from which they came.

Some definite conclusions can be drawn from this conference. First, there is as yet no general unemployment distress, although there is certainly unemployment, growing, as the mayors recognize, but not yet to such a stage as to have come to the attention of the Governors. There is a wide appreciation of the soundness of the build-now policy of public work, but there is an equally wide distribution of the reluctance to start, on account of high prices. There is no indication of a general going ahead in public or private building in spite of the high prices existing. There is a general demand that the railroads, which it was stated many times purchased 30% of all materials bought in the United States, start buying immediately, though, as Director General Hines told the conference, the failure to provide funds by the late Congress complicates the financial situation of the Railroad Administration to a point where it can promise nothing. There is a demand that freight rates on building materials be lowered, and lowered immediately. To this Director Hines promised his immediate attention. There is an appreciation of what is generally called the Bolshevik menace, but a confidence in the American people and its ability to meet it. There is a pronounced expectation of lowering in prices and no hope of a lowering in wages.

These are the impressions derived from the conference of representative men from all parts of the United States. That men holding pretty generally the same views could not get together and coördinate those views and specify remedies or expected remedies is undoubtedly due to the failure of the Department of Labor to provide the proper mechanism for the conference. These men came from all over the country with very little idea of what they were expected to do. They were made to put in three days listening to a number of things which they already knew, and were at the end hurried to a conclusion by lack of time. The resolutions prepared by some of the shrewdest politicians in the United States, and presented on the floor by a master of debate and oratory, were carefully calculated to avoid any controversial subject or to set down in good, round terms any definite program of action. Because the resolutions were adopted there should not be the impression abroad that they represent the feelings of the floor. Those who had hoped that the gathering together of so many men intimate with local conditions would develop a national policy of reconstruction must be disappointed.

F. C. W.

Guatemala Rebuilds After Earthquakes

That reinforced-concrete is the only safe type of construction for earthquake countries has been proved by the earthquakes of Guatemala and Salvador, in the opinion of Lee F. Whitbeck, chief engineer of the International Rys. of Central America. He points out that unfortunately this type of construction is expensive in these countries, as all materials have to be imported.

Reconstruction of the buildings of Guatemala City, the capital of Guatemala, after the earthquakes of December and January, 1917-18, is making slow progress, according to Mr. Whitbeck. This condition is due to scarcity of labor and materials, and apparently to a great lack of confidence on the part of property owners, as a result of the continuance of slight quakes. This fear is evidenced by a reluctance to start rebuilding and by the false economies that are being attempted in the work. The tendency is to adopt the cheapest possible method, and if there is any chance of patching a shattered wall, this is done usually, in preference to tearing down and rebuilding.

Reinforced-mud or "bajareque" is a common type of construction, which consists of a wood frame covered with lath, the wall space being then filled with mud and plastered. The effects that an artistic plasterer can obtain are said to be both surprising and deceiving.

Pennsylvania Has Emergency Public Works Commission

Body Provided For Two Years Ago To Tide Over Expected Periods of Depression Is Now Stimulating Construction

PENNSYLVANIA was particularly forehanded in providing against a possible industrial depression which might follow the war. By an act of the legislature, July 25, 1917, it established the Emergency Public Works Commission, "to provide for the expansion of the public works of the commonwealth during periods of extraordinary unemployment caused by temporary industrial depression." While the commission has not as yet done anything other than to stimulate various kinds of public work by the cities and counties of the state, it has a well considered program which, it is hoped, will help to ward off any actual depression in the next few months.

The act provides an emergency public-works fund, starting at $50,000 in the first appropriation, and constitutes a commission composed of the Governor, the auditor general, the state treasurer, and the commissioner of labor and industry of the state. The Department of Labor and Industry has the duty of ascertaining the existence of periods of extraordinary unemployment within the state and of notifying the commission. Then it is the duty of the commission to proceed to ascertain and obtain, from various departments, bureaus, boards and commissions, tentative plans for such expansion of the public works of the state as shall be best adapted to supply increased opportunities for advantageous public labor during periods of temporary unemployment. The industrial branch of the Department of Labor and Industry is also ordered, under the same act, to conduct an employment bureau for the use of the state departments which are engaged in such public work as the emergency calls for. When an industrial depression period does not exist the emergency public works fund is to be distributed among the various departments of the state, for such expansion of public works as are best adapted to advance public interests by providing the maximum of employment for the relief of existing conditions of extraordinary unemployment.

In November, 1918, a few days after the armistice was signed, the commission began to stimulate the public works of the cities and counties of the state through correspondence. Soon after, the commission requested the various departments of the state Government to report what useful necessary public work they could do during the demobilization period, provided the necessary appropriation and organization were forthcoming. Upon receiving this information, the commission made a report to the present legislature on the method of expanding public works in the state in the existing emergency. This report is now before the legislature for action.

The report takes up in order highways, forestry, factories, and public works in cities and counties. Under highways it recommends that the legislature should assign a percentage of the usual highway appropriation directly to the emergency public works fund, for emergency expenditure only during periods of unemployment, and that a percentage of all [illegible] bonds issued for highway construction should be [illegible] out of the market and sold only when a period of unemployment occurs, in order that the work may be done at that time. Emphasis is laid on the fact that the demobilization and transition period—from April to October, 1919—should be regarded as a possible period of temporary unemployment, and highway work concentrated then if necessary.

Under forestry, the report notes that the department of forestry of the state is contemplating certain forest work that could well be carried on at the present time, with the employment of 5000 unskilled laborers for three months. It is also noted that the water supply commission is prepared to undertake public works and stream conservation and flood control if a million-dollar appropriation is made. The investigations of this department are quite necessary for the continuance of a number of other public works.

The department of health has possibilities as an employer of labor at the present time, both in the construction of certain necessary sanitariums and in the work in destroying the mosquito. Notice is also made of the fact that for some years past the department of health has ordered certain boroughs to put in sewage-disposal plants, in order to relieve a menace to the public health. Some of these boroughs have not complied with the order, the reason given being that they have reached their debt limit. The report says that the question arises whether a part of the emergency public works fund could not be let to such boroughs in order that they may comply with the health department orders and also provide necessary public work at this time.

Certain taxes, notably the inheritance tax, could well be diverted toward the public works fund, according to the report. At any rate, the whole question of taxation in relation to this kind of work needs to be investigated. Finally, the report to the legislature emphasizes the publicity work that the commission can do in urging the minor political subdivisions of the state to enter into construction work at the present critical time.

The office of the commission is at the capitol at Harrisburg, and Otto T. Mallery is acting as executive secretary.

Standardizing Concrete Pipe

That design of concrete pipe should be standardized to the extent of adopting a certain range of diameters and five classes of varying strength, was the suggestion made in a paper read at the annual meeting of the American Concrete Pipe Association by C. F. Buente, of the Concrete Products Co., Pittsburgh, Penn. Length of pipe and type of joint are matters that, he thought, should be left to the judgment of the manufacturer. To obtain pipe of high quality and strength, he advocated the use of concrete made with a low proportion of water, but he did not know whether such concrete had been used for reinforced-concrete pipe. The meeting was held at Chicago Feb. 14-15. Officers of the association were elected as follows; President, W. E. Goodman, Saginaw, Mich.; secretary, G. E. Warren, Universal Portland Cement Co., Chicago.

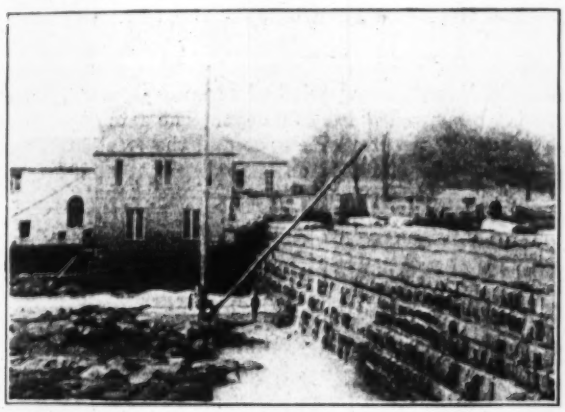
Old-Fashioned Methods Reduce Cost of Dam Repairs

Contractor Met Local Conditions and Avoided Expensive Operations Without Interrupting City's Water Supply

By Charles F. Dingman
Assoc. M. Am. Soc. C. E., Engineer, Flynt Building & Construction Co., Palmer, Mass., and New York City

TEN thousand dollars was appropriated by the City of Willimantic, Conn., to preserve the dam in the Natchaug River on which the water-supply and fire protection of the city depended. The contract was awarded for $7000 and the contractor, by the application of old-fashioned but economical methods that conformed to local conditions did the work for less than $4000, although estimates ran up to $39,000.

The dam is about three miles from the city and is of heavy stone-masonry construction, built in 1884. It provides a head of 21 feet, which is utilized to drive two Hunt-Smith hydraulic turbines, operating in turn two Worthington plunger-type pumps. These work at a normal speed of 80 strokes per minute and pump the water through a 12-in. cast-iron main to the reservoir near the city. A steam pumping plant has been provided for auxiliary purposes, but the expense of getting coal to the pumping station makes it necessary to use the auxiliary pumps only for emergency.



VIEW OF DOWNSTREAM SIDE OF DAM, TAKEN FROM SOUTH BANK

For some time past it had been noticed that the front, or downstream, face of the dam showed an appreciable bulge, extending for somewhat over 100 ft. of its total length of 280 ft. During the past summer this bulge reached such proportions as to cause fears for the safety of the entire structure, and an appropriation of $10,000 was obtained to defray the cost of repairs.

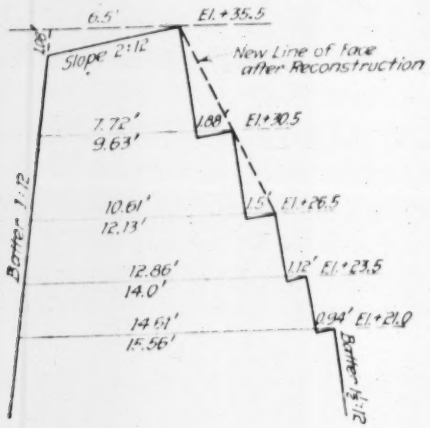
Water overtops the dam during a great part of the season, and, owing to the fact that the waste gates had not been opened for over a quarter of a century, some doubt was entertained as to the possibility of opening them at all so that the water could be drawn down to a point which would permit repairs without the use of expensive cofferdams and other temporary work. Doubts were increased when a diver found the stems of the two iron gates badly corroded and likely to twist off at the first attempt to turn them. The iron gates are 3 x 3 ft., and similar in design to modern sluice gates. In addition two wooden waste gates were provided. The stems of these, however, do not come up to the top of the dam.

The work of lowering the water apparently presented the greatest problem in the entire operation, and until this was done no inspection or plans could be made. The superintendent placed in charge of the work avoided the use of a diver in opening the gates by slinging a chain around the stem of one of the wooden gates, drawing it up and opening it. One of the iron gates was opened by making a new socket wrench sufficiently large to engage the end of the stem, and operating it in the usual manner. There was then some doubt of closing them again, but it was done without difficulty.

As soon as the water was drawn down below the top course of stone the coping was removed, and a large crevice was found. This crevice extended down for 10 or 15 ft. into the body of the dam, and was entirely filled with disintegrated mortar, decayed vegetation, etc. The crevice was undoubtedly caused by the action of water which found its way into the joints of the stone work, the successive freezing each winter causing it to become larger and larger. Although the masonry in the dam is composed entirely of large and heavy stones, there was no bonding between the face and the body of the dam, thus accounting for the facility of the frost action. This made it possible, however, to leave the rear or upstream portion of the dam in place while the front of the dam was removed. The profile of the dam, shown on the sketch (see next page), made it entirely feasible to do this, there being sufficient bulk remaining to make the use of a cofferdam unnecessary.

After the coping and front stone were removed and the disintegrated mortar, decayed vegetation and other

CONDITION OF DAM EXPOSED ON REMOVING COPING, AND SHOWING CRACK



CROSS-SECTION OF THE DAM

foreign matter were thoroughly cleaned out, the joints, wherever possible, were filled with grout, and the face was rebuilt to the new profile, shown in dotted lines on the diagram. The coping was then reset in cement mortar.

The stone was handled by a hand derrick, as shown in the photograph; this was the interesting feature of the work. Many who saw the work thought this method old-fashioned and inefficient, but it was adopted after much thought had been given to the relative cost of a steam and a hand derrick. The cost of moving a boiler and engine to the work, setting it in place, removing it, and returning it to the equipment yard would have greatly offset the probable cost of all the labor of operating the derrick by hand, and it would not have been possible to raise the stones in sufficiently rapid succession to pay for the higher cost of having an engineer constantly on duty. It is particularly difficult to get coal in this locality.

The various estimates for the cost of rebuilding the dam ranged as high as $39,000, this, of course, including the cost of building a cofferdam and other temporary structures. The Flynt Building and Construction Co., which obtained the contract, estimated the work at approximately $7000, with the stipulation that it be allowed to use its own judgment as to methods. The entire work was handled for a sum considerably less than $4000, and at no time was the water-supply interfered with in any way, nor was it necessary to use the emergency steam pumping system to maintain a sufficient pressure for the water-supply.

The City of Willimantic was represented in the operation by Charles A. Gates, mayor, Henderson S. Moulton, superintendent of water-works, R. E. Mitchell, city engineer, and William A. King, corporation counsel. The Flynt Building organization, which did the work was represented by L. H. Bogue, general superintendent, and Nelson M. Baldwin, division superintendent.

Concrete Sewer-Pipe Specifications Adopted by Los Angeles

Draft of 1919 Provides for One-to-Three Mix—Dimension Variations Fixed — Imperfections That Will Cause Rejections

LOS ANGELES in the spring of 1918 adopted pipe specifications for sanitary sewers whereby concrete pipe (called "cement pipe" in the specifications) might be used in place of clay pipe. The use of cement pipe caused a material lowering in the price of clay pipe. At the present time there is very little difference between the costs of the two. The latest specifications for the construction of sanitary sewers in Los Angeles were adopted by the council on Jan. 3, 1919. The main features of these specifications, as regards cement pipe, are as follows:

The cement pipe must be socket pipe of first quality, dense, tough, free from cracks. It must have a smooth interior finish and when struck with a hammer must give a metallic ring. The mixture used must not be less than one part of cement by measure to three parts of aggregate. No materials other than water, cement, sand and stone are permitted in the manufacture of the pipe. This prevents the use of waterproofing compounds. The cement and aggregate are subject to rigid inspection and test before use. The gravel or broken stone must not exceed one-half the thickness of the pipe for which it is used.

It is required that the pipe be made under cover, and the material used is machine mixed, molded and tamped. The city engineer has the right to inspect all materials, method of manufacture and finished pipe at all times. The pipe after manufacture must be kept thoroughly wet for a period of seven days, and not laid until it has cured at least 30 days. The date of making, the name of the manufacturer and the location of the plant must be stenciled on the outside of each length.

TABLE I. DIMENSIONS FOR CEMENT SEWER PIPE, LOS ANGELES, CAL.

Size	Thickness of Shell, In. Standard	Thickness of Shell, In. Deep and Wide Socket	Depth of Socket, In. Standard	Depth of Socket, In. Deep and Wide Standard	Minimum Annular Space, In. Standard	Minimum Annular Space, In. Deep and Wide Socket
6	¾	¾	2	2½	½	½
8	¾	¾	2½	2½	½	½
10	1	1	2½	2½	½	½
12	1¼	1¼	2½	3	½	½
15	1½	1½	2½	3	½	½
18	1¾	1¾	3	3½	½	½
21	1½	1½	3½	3½	½	½
24	2¼	2¼	3½	4	½	½

Limits of Permissible Variation in Inches

Per Ft. (—)	Depth of Socket (—)	Thickness of Shell (—)	Inside Diameter of Bore, In. (+ —)
⅛	⅛	⅛	⅛
⅛	⅛	⅛	⅛
⅛	⅛	⅛	⅛
⅛	⅛	⅛	⅛
⅛	⅛	⅛	⅛
⅛	⅛	⅛	⅛
⅛	⅛	⅛	⅛
⅛	⅛	⅛	⅛

Note. The minus sign (—) alone indicates that the plus variation is not limited; the plus and minus sign (+ —) indicates variation in both excess and deficiency in dimension.

Pipe 30 days old must appear, when broken, homogeneous, free from voids and generally uniform; and if containing stone must show pieces of fractured stone firmly embedded in the mortar.

All pipe over 6 in. is made in 2½-ft. lengths exclusive of sockets and 6-in. pipe may be either 2 or 2½ ft. in length. The thickness of the shell, the depth of socket and the annular space are given in Table I.

The following imperfections are considered injurious and cause for rejection:

1. When the bore or socket of the pipe varies from a true circle more than 3% of its nominal diameter.
2. A pipe or special designed to be straight, exhibiting a deviation from a straight line of more than ½ inch.
3. A single crack in the body of the pipe extending through the entire thickness, regardless of the length of such crack.
4. A single crack which extends through one-half of the thickness and over 3 in. in length.
5. Two or more cracks in the body of the pipe of a less length than 3 in., and extending through one-half the thickness.
6. Any crack which is more than ¼ in. wide at its widest point.
7. A piece broken from the spigot end deeper than the socket or longer than one-third of the diameter of the pipe; or a piece broken from the bell if the fracture extends into the body of the pipe or is longer than one-third of the diameter of the pipe.
8. Two or more breaks in the socket or spigot, unless they can be placed in the upper half of the sewer.

The tests for cured cement pipe are the same as for clay pipe and include: (1) Sand bearing crushing test; (2) hydrostatic pressure; (3) absorption test.

Table II gives the minimum strength that samples of cement pipe must develop in order to pass the crushing and hydrostatic tests.

Sanitary sewers are constructed within specified districts, by assessment. In order that sewer contractors may know in advance what their pipe will cost them, the city engineer's office calls for bids from manufacturers of cement and clay pipe for the amount of pipe required in the district before the ordinance of intention is passed by the council. The manufacturers are required to furnish bonds and guarantee the price for one year from the date when bids are received. Residents of the district may specify whether they desire cement or clay pipe used, by obtaining the signatures of more than 50% of the property owners. A. C. Hansen is city engineer of Los Angeles.

TABLE II

Size, In.	Minimum Crushing Strength (Lb. per Lin. Ft.)	Fracture at Not Less Than (Lb. per Sq. In.)
6	1430	40
8	1430	35
10	1570	30
12	1710	30
15	1960	30
18	2200	30
21	2590	30
24	3070	25

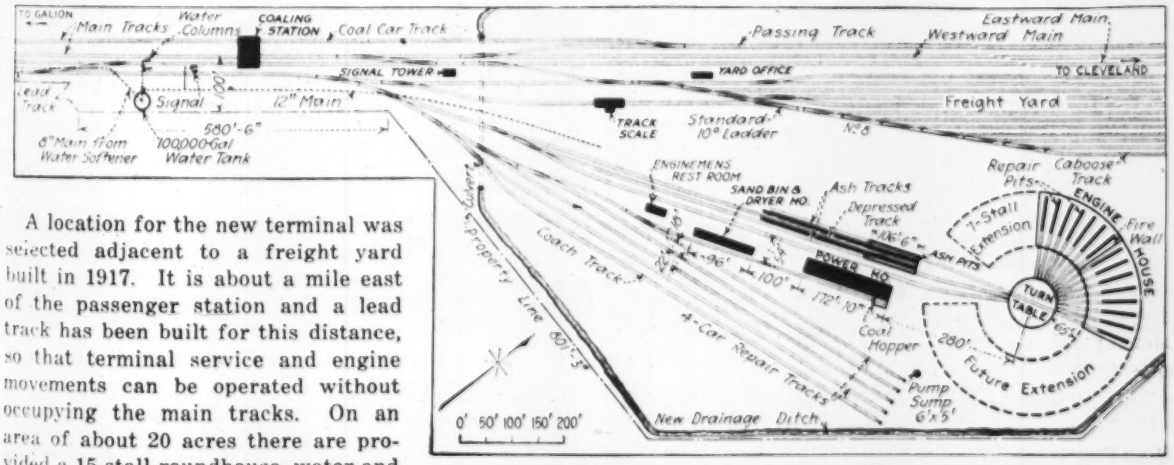
New Engine Terminal Outside City Avoids Congestion

Crowded Site Replaced by Facilities in Open Country—Water Stored and Treated—Standard Designs Employed—Engines Coaled on Three Tracks

REMOVAL of its engine terminals at Galion, Ohio, to a site in open country, beyond the city limits, has enabled the Cleveland, Cincinnati, Chicago & St. Louis Railway to design a new plant layout unhampered by existing facilities. Growth of the city around the old terminal, built in 1878, has made it impossible to extend this so as to provide the accommodation demanded by present traffic conditions, while damage by fire in 1917 necessitated hastening the construction of the new plant during 1918. About 20 engines daily have to be handled, cleaned and made ready for service, besides the train engines which take coal and water while standing on the main tracks.

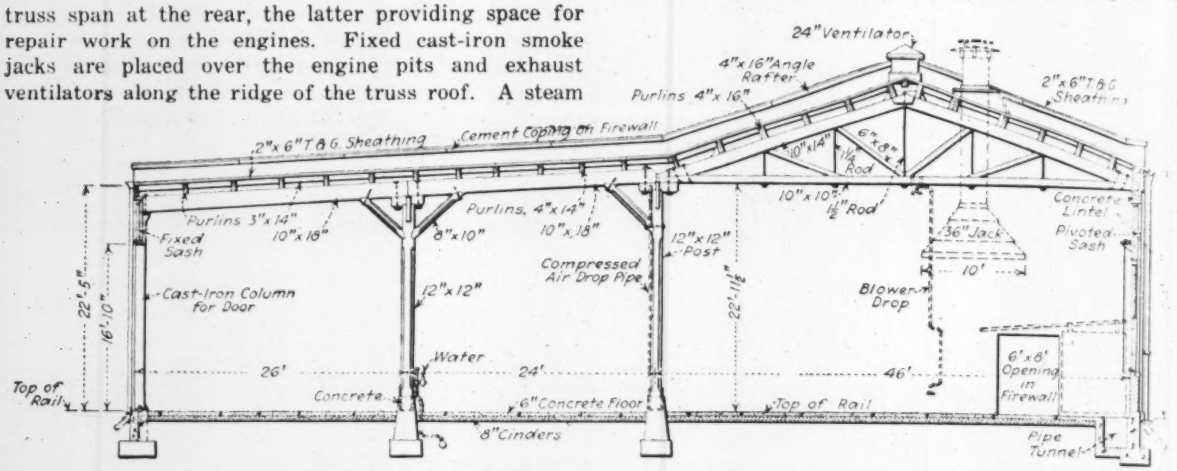
A location for the new terminal was selected adjacent to a freight yard built in 1917. It is about a mile east of the passenger station and a lead track has been built for this distance, so that terminal service and engine movements can be operated without occupying the main tracks. On an area of about 20 acres there are provided a 15-stall roundhouse, water and coaling stations, sand bin and dryer, two cinder pits, four car repair tracks for 53 cars, a coach storage track for 10 cars, a power house with shop and storeroom, and a rest house for the enginemen. Electrically operated machine tools for light repair work are installed in an annex of the power house.

The engine-house construction follows a general building design which was adopted as standard on this road a few years ago, and which provides for brick walls and timber roof, with cast-iron columns in the front wall for the attachment of swinging doors. Lintels over the wide window spaces in the rear wall were to have been of steel, but, owing to shortage of supply, they



ENGINE TERMINAL OF CLEVELAND, CINCINNATI, CHICAGO & ST. LOUIS RAILWAY AT GALION, OHIO

were made of reinforced concrete. Their span is reduced by two intermediate posts of 6-in. channels, resting on the concrete footings. A firewall divides the building into two sections. Two rows of wood posts on concrete pedestals support the roof framing, which consists of two beam spans at the front and a 46-ft. truss span at the rear, the latter providing space for repair work on the engines. Fixed cast-iron smoke jacks are placed over the engine pits and exhaust ventilators along the ridge of the truss roof. A steam pipe resting on the truss chords has vertical branches or drop pipes for use as blowers in engines which are having the fires started.



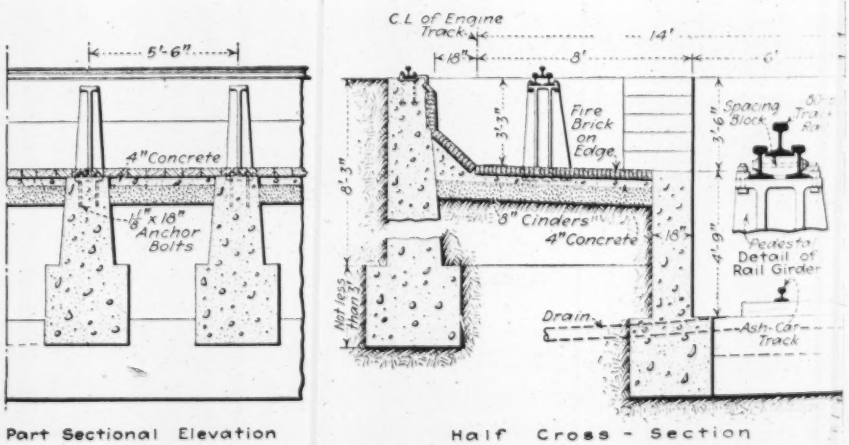
TIMBER FRAMING FOR ROUNDHOUSE ROOF, GALION, OHIO, ENGINE TERMINAL

At present the engine house is built for 15 stalls, but there is provision for a seven-stall extension. The angle between the radial tracks is 7½ degrees. Concrete pits 65 ft. long provide for inspection and repair, and have convex bottoms so that the floor will be dry for the men working under the engines. The side walls have corbeled projections on the inside to protect the water and steam pipes carried along the sides of the pit, while heavy projections on the outside provide supports for engine jacks. Track rails rest on steel plates and are fastened by clips and nuts on anchor bolts embedded in the walls of the pits. No drop pit is provided for taking out wheels and axles, the engines being raised by a jacking hoist with power-driven screw jacks to permit of such removal. The floor is of concrete, steel guards being bolted to the rails to form the flangeways. Pipes and electric cables are laid in a 3-ft. tunnel against the rear wall. In the 90-ft. center-bearing plate-girder turntable the pivot is a 20-in. flat disk with a device for securing a central bearing, this being a standard design on this road. The circular rail is laid on ¾-in. plates on a bench of the concrete wall and is secured by anchor bolts. At main entrance points, where there is impact as the entering load tilts the table, this rail is carried by a segmental 12-in. I-beam resting on short pieces of rail, all embedded in the concrete. Coupled to the corner of the table is a tractor with a 30-hp. motor driving a wheel which rides on the circular rail.

Steel bents with H-beam posts are embedded in the wall of the pit to support the ends of the tracks and thus prevent their depression due to the impact of engines passing off the turntable. There are three approach tracks, two of these being the ashpit tracks and the third a running track which permits of direct movements to and from the turntable. A 65-ft. open space extends between the roundhouse and the turntable.

Mechanical equipment is not provided for removal of ashes from the pits where the engines have their fires cleaned or dropped, the reason given being that such equipment has been found unsatisfactory in operation and expensive in maintenance. The ashpits are of the depressed-track type, 100 ft. long, with two engine tracks spaced 28 ft. on centers and having between them an ash-car track at a lower level but rising to the surface on a grade of 4 per cent. Side-dump cars are used, having A-shaped floors and being of such height that the ashes can be shoveled into them readily from the floors of the ashpits.

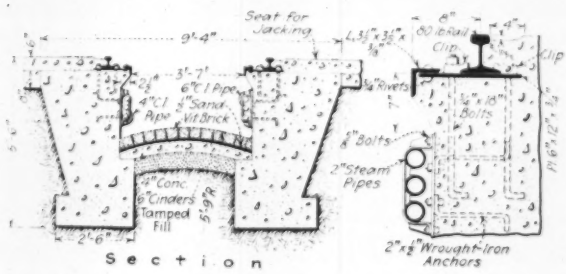
Each engine track has its outer rail carried on the



ENGINE ASHPITS HAVE DEPRESED TRACK FOR ASH CARS

side wall of the pit and its inner rail on a girder supported by cast-iron pedestals, as shown in one of the drawings. This girder consists of a pair of 80-lb. rails bolted together through spacing blocks upon which the track rail rests. Thus the heads of the former fit over the base of the latter and grip it firmly when the bolts are tightened. Spacing blocks 22 in. apart and 6 in. long are used; except that 18-in. blocks with four bolts are used under the rail joints. The track rail on the wall has the inner side of its base gripped by a continuous angle which protects the corner of the wall and is secured by anchor bolts. On the outer side the base is held by clips on similar bolts.

Water-supply for the locomotives and for the service of the terminal is taken from a small creek; a dam forms a pump pit. An electric pump delivers the water to a 17,000,000-gal. reservoir formed by an embankment across low ground alongside the creek and providing storage for low-water periods. From this the water is pumped to a water-softening plant, whence it flows to a 100,000-gal. wood tank placed at such an elevation as to give a gravity flow to a similar tank at the entrance to the engine terminal. The latter distributes a gravity supply to the buildings and to two water columns at the coaling station and two at the cinder



DETAILS OF ENGINE PITS

pits. An 8-in. main connects the two tanks and a 12-in. main leads from the yard tank to the 10-in. water columns and to the buildings.

Engines on three tracks are served by the coaling station, which has a 400-ton bin spanning the two main tracks, with chutes on one side for delivery to engines on the lead track. On the other side is the coal-car track, with a receiving hopper from which the coal flows to a single 1½-ton bucket working automatically in an elevator tower. The bin is of timber and is supported by steel girders which span the tracks and are carried by steel bents, the lower portions of these being inclosed in concrete walls as a protection against blows from derailed engines and cars. Sand is screened and dried in a separate building and is delivered to the engines through pipes by compressed air.

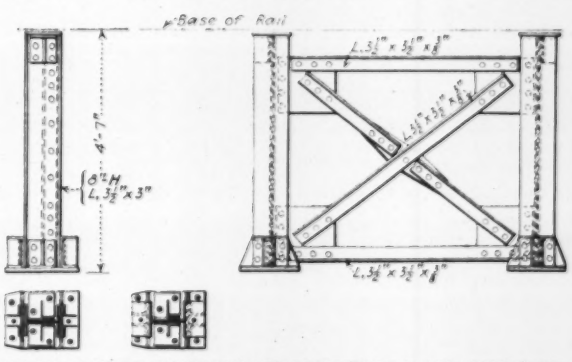
In the power house are two 200-hp. marine boilers and a compressor. This plant furnishes steam for heating and for the engine-house blowers, compressed air for operating tools and testing brakes, and hot water for washing out the engine boilers.

Some grading was required to prepare the site, and a drainage ditch crossing it was replaced by a ditch excavated along the boundary line and carried under the tracks in a 36-in. sectional cast-iron culvert. Drainage and sewage from the buildings, yard, turntable pit

COALING STATION SERVES MAIN TRACKS AND LEAD TRACK TO TERMINAL

and other points are carried by a system of clay pipe and concrete pipe drains to a manhole or sump, where a float-controlled electric pump raises the water about 8 ft. to an outfall pipe discharging into the ditch. The soil is a yellow clay, changing to a stiff blue clay which makes a good foundation. Piles are used only under the footing for the turntable center. Woven-wire fencing which incloses the site is carried by concrete posts designed and made by the railway.

Plans for this engine terminal plant were made under the direction of C. A. Paquette, chief engineer of the railway, and the work was in charge of W. C. Kegler, district engineer at Galion (and W. S. Burnett



STEEL BENTS IN WALL OF TURNTABLE PIT SUPPORT ENDS OF TRACKS

during the illness of Mr. Kegler), with J. Humphries as assistant engineer. The Walsh Construction Co., Davenport, Iowa, has the contract for the buildings, turntable pit and cinder pit. The coaling station was built by the Ogle Construction Co., Chicago, and the turntable by the American Bridge Co. Laying the 8-in. and 12-in. water mains from the water-softening plant to the terminal tank and water columns was done by the railway forces.

Hydraulic Efficiency of a Drainage Ditch for Five Different Channel Conditions

Photographic Views and Tabular Data for Varying Channels Show Effect of Straight and Curved and Clear and Obstructed Courses

By C. E. Ramser
Senior Drainage Engineer, United States Bureau of Public Roads

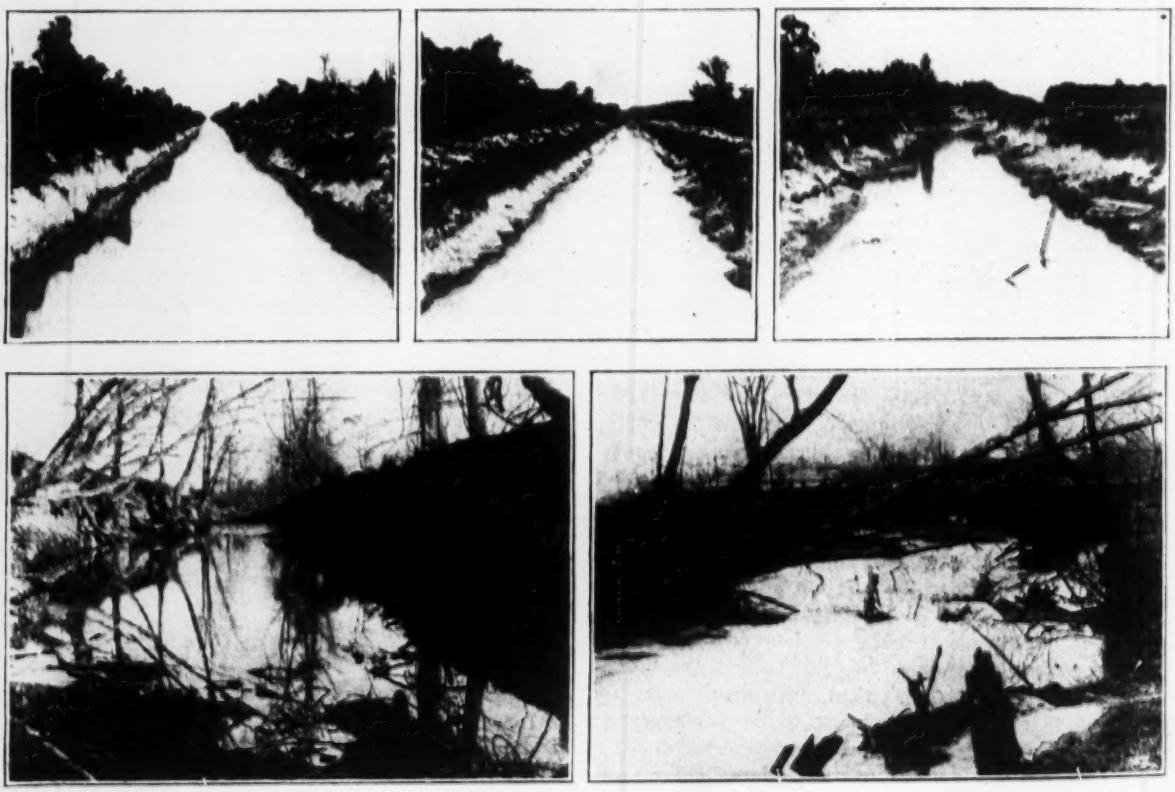
EXPERIMENTS to determine the values of n in Kutter's formula

$$C = \frac{\frac{1.811}{n} + 41.66 + \frac{0.00281}{s}}{1 + \frac{n}{\sqrt{r}}\left(41.66 + \frac{0.00281}{s}\right)}$$

were made on five courses of the South Forked Deer River between Jackson and Roberts, Tenn. The channel along these courses varied from a newly dredged channel, in excellent condition, to a very crooked course of the old river channel, in very bad condition. Views of these courses of channel are shown in Figs. 1 to 5. In Tables I to V are given the values of n obtained for each of the courses for stages ranging from low to high, and a full description of the conditions existing along each of the courses.

As may be seen from the tables, the lowest values of n were obtained for the course of channel near Roberts (Fig. 1). Values of n were determined for this course from four to six months after the dredging of the channel had been completed. The low values of n obtained for this course as compared with the values for the other courses may be attributed to the comparatively smooth and regular side slopes and bottom, the uniformity of cross-section, and the freedom from growth or obstructions in the channel.

The effect of roughness and irregularities in the lower portion of the channel is revealed in the results obtained for the course near Jackson (Fig. 2 and Table II.) Although the channel was practically free from vegetation or obstructions of any sort, yet the values of n are considerably higher than those obtained for the course near Roberts. The irregularities in the lower portion of this channel were left at the time of construction, the bottom and sides of the channel never having been smoothed properly. The values of n for this course were determined from nine to 12 months after the construction of the channel.



FIVE COURSES OF THE SOUTH FORKED DEER RIVER, TENNESSEE, SHOWING DIFFERENT CHANNEL CONDITIONS

Fig. 1—Straight and uniform. Fig. 2—Straight and rather poor. Fig. 3—Straight and irregular. Fig. 4—Fairly straight but irregular. Fig. 5—Irregular and obstructed

The numbering of the views corresponds with that of the tables. Fig. 1 is a view taken near Roberts; Fig. 2, near Jackson; Figs. 3 to 5 near Campbell's levee road.

TABLE V.—HYDRAULIC ELEMENTS OF THE SOUTH FORKED DEER RIVER IN FIVE STRETCHES BETWEEN JACKSON AND ROBERTS, TENN.

TABLE I.—NEAR ROBERTS

Average surface width, 60 ft.; average depth at center, 13 ft.; gage height at bankfull stage, 10.5. Course, straight, 1412 ft. long. Cross-section, very uniform, sides regular and smooth; Bottom, even and fairly smooth; Soil, lower part, sandy clay; upper part, clay loam; Condition, no vegetation or obstructions of any kind in channel. Constructed: October, 1915.

Gage Height, Ft.	Date of Observation	Discharge, Sec.-Ft.	Average Cross-Section Area, Sq. Ft.	Mean Velocity, Ft. per Sec.	Mean Hydraulic Radius, Ft.	Slope	c	n
5.20	2/26/16	614.3	328.4	1.87	5.76	0.000094	80.5	0.0255
5.00	2/10/16	798.2	390.0	2.04	6.50	0.000094	82.6	0.0254
5.62	5/29/16	919.4	421.8	2.18	6.84	0.000096	85.2	0.0252
6.40	4/4/16	1252.1	465.0	2.70	7.28	0.000124	90.0	0.0240
6.90	5/4/16	1502.6	494.0	3.04	7.55	0.000166	86.0	0.0248

TABLE II.—NEAR JACKSON.

Average surface width, 55 ft.; average depth at center, 10 ft.; gage height at bankfull stage, 12 ft. Course, straight, 952 ft. long; Cross-section, fairly uniform; side slopes, fairly regular near top but very irregular and uneven at bottom; Bottom, very uneven and full of holes; Soil, heavy clay loam; Condition, no vegetation or obstructions in channel; Constructed, March, 1916; General remarks, high values of *n* are due to very rough and irregular condition of channel originally dredged; the upper portion of channel is fairly regular.

Gage Height, Ft.	Date of Observation	Discharge, Sec.-Ft.	Average Cross-Section Area, Sq. Ft.	Mean Velocity, Ft. per Sec.	Mean Hydraulic Radius, Ft.	Slope	c	n
6.39	12/13/16	191.6	115.9	1.66	2.89	0.000530	42.4	0.0420
6.95	12/20/16	282.2	143.0	1.97	3.33	0.000555	45.8	0.0402
7.00	12/22/16	290.4	147.0	1.98	3.40	0.000562	45.5	0.0401
7.09	3/31/17	375.0	150.0	2.50	3.46	0.000694	51.2	0.0362
7.48	2/23/17	433.0	166.0	2.61	3.69	0.000630	54.2	0.0348
7.77	1/17/17	477.0	178.0	2.68	3.87	0.000642	53.8	0.0349
11.30	12/28/16	1078.0	344.0	3.13	5.69	0.000477	60.2	0.0341
11.78	1/31/17	1296.0	366.0	3.55	5.83	0.000534	63.6	0.0322
12.48	1/6/17	1362.0	399.4	3.41	6.10	0.000436	66.1	0.0310

TABLE III.—IRREGULAR DREDGED CHANNEL.

Average surface width: 61 ft.; average depth at center, 14 ft.; gage height at bankfull stage, 9.0 ft. Course, straight, 534 ft. long; Cross-section, considerable variation. Side slopes, very irregular; Bottom, very rough and uneven; Soil, sandy clay loam; Condition, very little vegetation, few obstructions; Constructed, August, 1914.

Gage Height, Ft.	Date of Observation	Discharge, Sec.-Ft.	Average Cross-Section Area, Sq. Ft.	Mean Velocity, Ft. per Sec.	Mean Hydraulic Radius, Ft.	Slope	c	n
2.5	3/20/16	195.2	176.1	2.24	3.61	0.000571	49.4	0.0380
3.52	2/25/16	545.9	249.0	2.19	4.65	0.000552	43.2	0.0455
4.30	3/29/16	735.7	305.0	2.41	5.33	0.000452	49.2	0.0410
4.45	3/4/16	715.1	315.6	2.27	5.45	0.000300	56.2	0.0367

TABLE IV.—OLD STRAIGHT RIVER CHANNEL.

Average surface width, 48 ft.; average depth at center, 13.5 ft. Course, fairly straight, 497 ft. long; Cross-section, considerable variation; Side slopes, irregular; Bottom, irregular with deep holes; Soil, sandy clay loam; Condition, sides of channel covered with trees, roots and vines, and subject to caving; logs, branches and other drift in bottom of channel.

Gage Height, Ft.	Date of Observation	Discharge, Sec.-Ft.	Average Cross-Section Area, Sq. Ft.	Mean Velocity, Ft. per Sec.	Mean Hydraulic Radius, Ft.	Slope	c	n
2.5	3/20/16	395.2	196.2	2.01	4.44	0.000584	39.5	0.0500
3.52	2/25/16	545.9	240.2	2.27	5.09	0.000734	37.2	0.0550
4.30	3/29/16	735.7	275.0	2.68	5.56	0.001088	34.4	0.0620
4.45	3/4/16	715.1	281.9	2.54	5.66	0.000952	34.6	0.0619
7.00	2/3/16	1066.6	403.2	2.64	7.19	0.000501	44.1	0.0505

TABLE V.—OLD CROOKED RIVER CHANNEL.

Average surface width, 63 ft., average depth at center, 14.0 ft; Course, very crooked, made up of four distinct curves, 705 ft. long, at low water, 740 ft. at high water; cross-section, large variations; Side slopes, very irregular; Bottom, very irregular and full of holes; Soil, sandy clay loam; Conditions, many roots, trees and bushes on side slopes and many logs, large trees and other drift on bottom; trees are continually falling into channel, due to caving banks.

Gage Height, Ft.	Date of Observation	Discharge, Sec.-Ft.	Average Cross-Section Area, Sq. Ft.	Mean Velocity, Ft. per Sec.	Mean Hydraulic Radius, Ft.	Slope	c	n
2.5	3/20/16	395.2	241.2	1.64	4.15	0.003773	13.1	0.1520
3.52	2/25/16	545.9	311.5	1.75	4.99	0.003812	12.7	0.1620
4.30	3/29/16	735.7	366.0	2.01	5.56	0.003450	14.6	0.1500
4.45	3/4/16	715.1	376.7	1.90	5.68	0.002709	15.3	0.1460
7.00	2/3/16	1066.6	575.8	1.85	7.60	0.001486	17.4	0.1400

TABLE VI.—RELATIVE CAPACITIES FOR THREE COURSES OF CHANNEL.

Cross-section area = 315.6 sq.ft.
Hydraulic radius = 5.45 ft.
Slope = 0.0003

Courses of Channel	*n*	*c*	Mean Velocity Ft. Sec.	Discharge Sec.-Ft.	Relative Capacities of Courses Per Cent
Dredged	0.0367	56.2	2.27	715.1	100.0
Old straight	0.0619	34.8	1.40	443.5	62.1
Old crooked	0.1460	15.1	0.61	192.7	27.0

Figs. 3, 4 and 5 represent three consecutive courses of channel located near the Campbell's levee road below Jackson. The different courses of channel are a straight course of the old river channel, a very irregular and crooked course of the old river channel, and a straight course of a newly dredged channel with irregular cross-section. Gagings of the flow were made at the upper end of the course of the dredged channel, and were used in the computations of values of *n* for all three courses. The advantage of this practice lies in the fact that an error in discharge would not materially affect the relative values of *n*, so a ready comparison can be made of the hydraulic efficiency for the three courses of channel. The values of *n* obtained and a careful description of the three courses are given in Tables III, IV and V. The conditions found in the two courses of old river channel are typical of old channel conditions in this section of the country. The dredged course of channel is considerably more irregular in cross-section than the courses near Jackson and Roberts, shown in Figs. 1 and 2, which accounts for the higher values of *n* obtained.

Referring to Tables III, IV and V, it is seen that the values of *n* for the discharge of 715.1 sec.-ft. are 0.0367, 0.0619 and 0.146 for the dredged, old straight, and old crooked channels, respectively, and that the slope of the water surface required for this discharge was over three times as much for the old straight as for the dredged channel. In order to show the relative capacities for these three course of channel for the values of *n* given above, Table VI was prepared, in which the slope, the hydraulic radius, and the cross-section area of the last set of measurements in Table III were used.

The difference in the relative capacities of the old straight and the old crooked channels is not due entirely to the curves in the latter, since the accumulation of trees, logs and other drift was greater in the crooked channel. However, the difference in the condition of the two channels may be directly attributed to the presence of the curves, since there is a greater tendency for drift and obstructions to accumulate in a curved than in a straight course of channel.

Wood-Block Pavement Has Spread Two Inches

The wood-block pavement on Market St., Chattanooga, Tenn., was 70 ft. wide and has increased in width 2 in. during the three years which this pavement has been in place, according to Robert Hooke, city engineer. This expansion has been taken up, by a reduction of the expansion joint on either side of the pavement, to one-half of its original size. Mr. Hooke attributes the spreading of the pavement to the working of solid particles of grit into the spaces between the blocks at times when the pavement was fully contracted.

Day Labor Does Municipal Work at Flint, Michigan

Engineer Favors Direct Employment for Cities of Moderate Size and Contract System for Small and Large Cities

CONSTRUCTION of sewers, paving and sidewalks, and cleaning of streets, are done at Flint, Mich., by day labor under the direction of the city engineering department. Consequently, the department must have men who are capable of directing work and handling labor, but this is a difficult problem, because men thus qualified are much in demand by contractors and others. In a paper read at the annual meeting of the Michigan Engineering Society Ezra C. Shoecraft, city engineer, said that during and since 1915 all sewer and paving work have been done in this way, except a small amount of asphalt-block paving laid in 1917. Sidewalks have been built by day labor since 1912. In the past four years the work has amounted to about 83 miles of sewers, 27½ miles of paving and 54 miles of sidewalk.

Costs and results have been satisfactory, compared with those in other cities, according to Mr. Shoecraft, who also states that the work is as good as, and generally better than, that done by contract, that it is done more expeditiously, that more consideration is given to the property owners affected by the improvements, and that urgent work receives first attention.

Good equipment is largely responsible for the success of the system. The equipment is put on each separate job on a per diem basis and is entirely self supporting, including allowance for depreciation. The original cost of the plant, including small tools, was $15,000. All machines are of a class that is generally applicable; thus those which can be used only on special jobs are avoided.

The pavement plant includes two revolving steam shovels; two concrete mixers for curbs; two mixers of 14-ft. capacity for foundation work; a 10-ton roller; an eight-ton gasoline tandem roller for asphalt; an asphalt plant capable of producing material for 1500 sq.yd. of 2-in. surface in 10 hours; five asphalt wagons of 2½ yd. each; four 5-ton dump trucks; six dump wagons; a two-ton truck; a wagon loader; an auto crane, and a dragline excavator at the gravel pit. For sewer construction there are two trench excavators for 5 x 20 and 3 x 15-ft. trenches; a backfiller; a trestle and bucket machine for large sewers, and two 600-gal. trench pumps. For sidewalk work there are eight wheeled scrapers and two concrete mixers.

Street cleaning was turned over to the engineering department about July, 1917. The equipment includes two power-operated flushers with 1200- and 1800-gal. tanks. The annual cost of street cleaning and snow removal approximates 4c. per square yard. Mr. Shoecraft believes that still greater efficiency may be secured and that the ideal street-cleaning machine has not been invented.

The day-labor system is not recommended for small cities, Mr. Shoecraft says, as it would be too expensive for them to maintain a trained force for their relatively small needs. Flint has about 90,000 inhabitants.

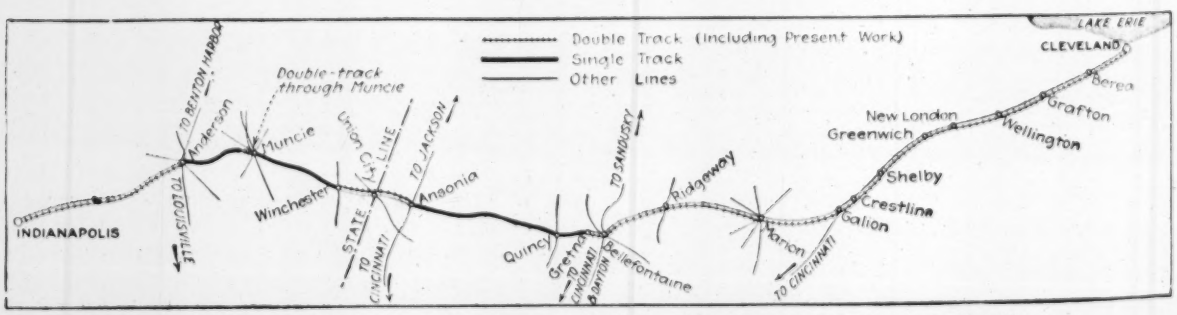
Double-Track Improvement on Big Four Railroad

Study of Operating Conditions for Heavy Traffic Leads to Extending Second Track and Reducing Grades

INCREASE in traffic capacity, more rapid forwarding of freight, and eventually—on some parts of the territory—an increase of train loads from 2200 to 4000 tons, are operating advantages which will be effected by the double-tracking and grade-reduction work and other improvements on the Cleveland and Indianapolis division of the Cleveland, Cincinnati, Chicago & St. Louis Ry. This 283-mile line is the busiest division of the "Big Four" system. It has about six passenger trains and seven scheduled freight trains each way daily, but the traffic density is much greater than would be indicated by the number of scheduled trains. The actual total number of trains during the war period, with the heavy traffic in munitions and supplies, has been as high as 40 to 50 daily.

In this distance there are 150 miles of double track, which the work in progress will increase to 200 miles. This includes the 20-mile stretch between Galion and Marion, Ohio, where the parallel and adjacent single-track lines of the "Big Four" and the Erie railways are operated jointly as a double-track line. Other improvements include an extension of the west-bound yard at Bellefontaine and new engine terminals at Galion and Ansonia, Ohio. At present the maximum grades are 0.8 per cent., in short stretches, but with the completion of the improvements this will be reduced to 0.3 per cent., with some temporary exceptions, as noted below.

The economic and operating phases of the work are



DOUBLE-TRACKING ON 283-MILE HEAVY-TRAFFIC LINE OF CLEVELAND, CHICAGO, CINCINNATI & ST. LOUIS RAILWAY

of primary importance, the construction phase involving no great difficulty. The improvement thus far authorized is not expected to permit of hauling heavier train loads, but it will permit the handling of trains with a great saving in time, due to the elimination of delays from side-track detentions and congested conditions at various points.

Two engine districts compose this division: One is 135 miles, from Indianapolis to Bellefontaine, and the other is 140 miles, from Bellefontaine to Cleveland. Hitherto the maximum train loads permissible over the ruling grades have not been handled through these districts, because of the great distance and the fact that the delays and congestion attending the dense traffic would make it impracticable to handle such trains within the time limits for working hours of train crews, as imposed by law. Changes in the engine districts were considered, but the other methods of meeting the difficulty were considered preferable. In this connection, reference may be made to the rearrangement of a 309-mile division on the Great Northern Ry. into three engine districts instead of two, in order to keep within these time limits, as described in *Engineering News-Record* of Sept. 5, 1918, p. 439. In this case, however, the traffic was very much lighter than that on the Indianapolis and Cleveland line.

Ruling Grades Not All Eliminated

While grade reduction is included in the present improvement, it does not eliminate all the ruling grades in either of the two train districts, but at certain points these ruling grades will still remain on single-track sections outside of the double-track construction now authorized. The new double track, as built for some distance both east and west from Bellefontaine, and, therefore, including both the train districts, is also laid at the old grades, of 0.8 per cent., which are ruling grades, except that east-bound from Bellefontaine the ruling grade is 0.5 per cent. If the two districts were so improved as to reduce the grades at all other points, it would be possible to increase the train loads correspondingly, using pusher engines on the Bellefontaine grades. On the remaining portions of the districts, therefore, the maximum grades on the new double-track work are 0.3 per cent. These portions are being thus treated with a view to their becoming parts of a low-grade line between Indianapolis and Cleveland, such as will be attained eventually either by the reduction of present grades, by the construction of low-grade detours around the heavy-grade sections, or by the application of helper service.

In the case of this division, the need of immediate relief—at least to the extent attainable by double tracking both ways from Bellefontaine and at certain other places, as now in progress—was so pressing as to leave no alternative. Previous experience of this railway as to benefits from double tracking elsewhere under approximately similar conditions left no doubt as to the economy of this particular improvement, which was undertaken, therefore, without making such close study and estimates as would have been necessary to demonstrate the full measure of the benefits which will be derived.

Work now in progress includes the widening of present fills and also the construction of new and higher fills on the present location, in order to substitute long unbroken grade lines for the original irregular profile. It includes three sections, as shown on the accompanying map. From Marion, Ohio, west to Harper, 33 miles, the work is mainly in widening the old fills, and requires relatively light grading. From Ansonia, Ohio, to Union City, eight miles, the subgrade elevation is raised considerably, in order to reduce grades by taking out existing sags. From Union City to Winchester, Ind., 10 miles, there are both widening and raising of fills. The estimated cost is $1,180,000 for the work from Marion to Harper, and $820,000 for that from Ansonia to Winchester. As this line traverses mainly an elevated plateau there are few cuts of importance and few structures other than culverts.

Double Tracking and Passing Tracks

In double tracking, the new second track is in some places on the north and in other places on the south of the old track, which arrangement permits of some improvement in curvature and also permits of taking advantage of the best location for grading and other local conditions. Present passing tracks, which are about six miles apart, are linked into the double track, being ballasted to standard section and relaid with new rails. Passing tracks are required also on the double-track sections, where they are spaced about 10 miles apart, their location being determined more by the occurrence of yards, towns and road crossings than by any specific interval or spacing. These new passing tracks are made long enough to take 100-car trains.

Train movements will be facilitated greatly by the installation of automatic block signals, which it is expected to install later. With this system the block sections will be about one mile in length, as compared with six to seven miles under the present manual-block system, which has towers at the passing track connections.

Rails for the new tracks are of the A. S. C. E. 90-lb. section with four-bolt joints, laid on ties of red oak and similar woods which are creosoted at the railway's plant. Main tracks are spaced 13 ft. on centers and the spacing of main and passing tracks is 16 ft. on centers. Concrete posts of the railway's design and manufacture carry the woven-wire fencing, special braced posts being used at corners and end panels. Mile posts and rests for spare rails are also of concrete.

These improvements are under the direction of C. A. Paquette, chief engineer of the Cleveland, Cincinnati, Chicago & St. Louis Ry. W. C. Kegler is district engineer for all the present work, with F. N. Johnson as resident engineer on the section from Marion to Bellefontaine and T. E. Earle as resident engineer from Ansonia to Winchester.

Railways Should Report Road Crossings

Legislation requiring railways to obtain the approval of the Wisconsin Railway Commission for all new road crossings and abandonment or change of existing crossings is suggested by the commission. Discovery of new crossings established without any report of the fact by the railway to the commission is the reason for this suggestion.

Smooth, Dustless Roads Maintained by Gang System

Bituminous Carpet Placed on Macadam Highways in Michigan Fruit District —Slag Has Proved Satisfactory for the Metal on These Roads

BITUMINOUS carpets maintained by the gang system, as distinguished from the patrol system, are used to cover the slag and stone macadam roads in the Berrien County, Michigan, fruit district. Thus smooth and dustless highways for the hauling of perishable fruit to market are produced. While stone has been used generally for these roads, slag is coming into favor and is said to be giving excellent results. Reports indicate that stone is preferred when bituminous treatment is not contemplated, while many favor slag when such treatment is to be applied.

BITUMINOUS CARPET PROTECTS EIGHTEEN-YEAR-OLD MACADAM ROAD IN BERRIEN COUNTY, MICHIGAN

As stated above, an important factor in deciding road questions in this county is the fruit industry. Peaches, grapes and berries in large motor-truck loads will not reach the shipping point in good condition if bumped over rough roads and covered with dust. Therefore, farmers in this district insist on having the roads maintained in first-class shape. Furthermore, the elimination of dust is of great value to fruit growers whose farms border the highways. One of the accompanying views shows the West Michigan Pike—an 18-year-old water-bound macadam which has received a bituminous treatment.

While slag has been used extensively in Michigan for several years as the base course for stone and gravel surfaces, only in recent years has it been employed for the top course. It is a little more troublesome to compact slag than stone in thin courses, and, according to Frank F. Rogers, state highway commissioner, stone is preferable for the wearing course in water-bound macadam, as the lower cementing property of slag causes it to ravel more quickly under automobile traffic. Where a bituminous carpet is to be applied, however, slag is said to make a very satisfactory surface on which to place the coating. In fact, it is said to be superior to gravel and stone, since it not only is sharp and irregular, but has minute cells which receive the bituminous material, thus causing the carpet to adhere.

Slag has proved satisfactory for two miles of macadam in Berrien County, it is stated, and is now being used quite extensively. An example of this is found in Benton Township, which is now building 22 miles of slag-macadam road under a bond issue of $100,000. As this sum was not sufficient to construct the roads under conditions of increased material and labor cost, the township board adopted a policy of building the slag base on all the roads and utilizing it for traffic until funds for surfacing are available. One of the views shows the township unloading and distributing plant at Benton Harbor, which, with a force of only three men, keeps 16 teams and two motor trucks busy.

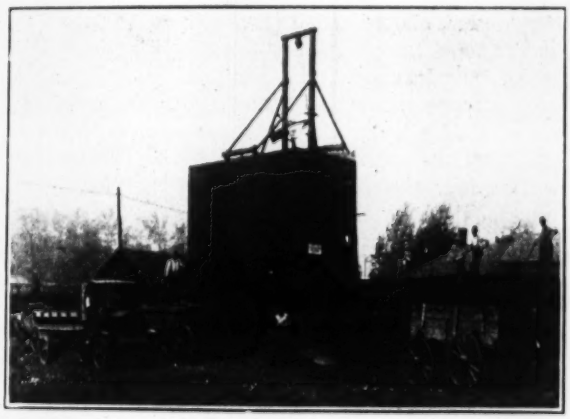
Macadam county roads for which state aid is desired must be built in conformity with the specifications of the state highway department, under whose instructions and specifications the county engineer works. Township roads are also built according to the state specifications under the supervision of a highway commissioner, the county engineer being generally employed to make road surveys, check the grade and do some inspection work. The state specifications, with few exceptions, follow those used elsewhere for macadam roads. The stone, whether limestone or slag is used, must be well graded and of sizes from 1½ to 3½ in. This grading is the same for both the top and bottom courses. Screenings are described as that portion of the crushed material passing a ¾-in. screen, including the chips, but with all but 25% of the dust removed. Dust is described as that portion passing a No. 8 sieve. The engi-

neer for the company supplying the slag maintains that this dust should be left in the screenings for the top course, as it would give better cementing properties.

Side boards, supported by iron pins driven into the subgrade, are used as forms and to insure proper thickness of material. These forms are used for both the top and bottom courses. To obtain adequate rolling, the county specifications require that, before starting to lay stone, the contractor shall have one roller on the work for each 100 cu. yd. of material which he expects to deliver per 10-hour day; also the necessary pumps and sprinkling outfits. Rollers shall weigh from 10 to 15 tons. The compacted thickness of the bottom course is required to be 4 in., while that of the top course is such as will give a final thickness of not less than 7 in. at the edges and 8 in. at the center, for 9 to 16 ft. paved width.

As a rule, the bituminous carpet cannot be applied immediately after the completion of the top course, as the road is then covered with more or less loose screenings, which prevent proper adherence. In general, it is thought best to permit the use of the top course by traffic until it has become thoroughly compacted and bound by the cementing action of the material. Experience in some cases indicates that water-bound slag macadam can carry traffic for a longer period than stone before the carpet is applied.

For the bituminous carpet the county uses asphalt with both stone and slag screenings from ¼ to ½ in. in



THIS UNLOADING PLANT KEEPS SIXTEEN TEAMS AND TWO MOTOR TRUCKS BUSY

size. After the surface has been swept thoroughly, the asphalt is applied at the rate of ¼ to ½ gal. per square yard, by means of a 700-gal. tank wagon having a heater to keep the contents at about 320° F., and an air pump to maintain a pressure of from 30 to 60 lb. per square inch. An illustration shows one of these outfits at work. The asphalt is usually applied with a hose fitted with a ⅜-in. nozzle, which sprays the material downward, in conical form. This enables the man in charge to vary the quantity according to the condition of the road. Screenings averaging from 18 to 25 lb. per square yard are then spread and rolled, and the road is immediately opened to traffic. The carpet is said to stand up well under heavy motor-truck traffic; what wear occurs is usually in the form of holes of varying size, rather than in long ruts.

The width of roadway is 24 ft. between ditches, and the paved width is from 9 to 18 ft., according to the importance of the road. Shoulders are built before the stone or slag is deposited, the earth being filled against the side forms. In the final rolling, after the side forms have been removed and the space has been filled, the shoulders as well as the macadam are rolled. Main county roads passing through villages are paved for the full width of the street, the village paying for the extra width over the standard 16 ft. This system has greatly

ROLLER HAULS HOT ASPHALT SPRAYING OUTFIT WHILE LAYING BITUMINOUS CARPET

facilitated the construction of through routes. In such cases the village can specify the kind of paving to be used within its limits.

Drainage of the subgrade in the country sections is provided by lateral drains of coarse stone or slag laid through the earth shoulders to the ditches. These are about 100 ft. apart on both sides of the road, and are staggered so as to give one drain for every 50 ft., with one on each side at all low points. Storm-water drainage on grades is provided for by wide concrete gutters ending in an apron or spillway at the foot of the grade, which discharges the water clear of the roadway. On high fills a similar gutter is used, with a concrete spillway down the slope to prevent washing. Under the cross roads, which are paved similarly to the main roads for a distance of 33 ft., side ditches are carried by 10- or 12-in. sewer pipe cased in 3 in. of concrete where the covering is shallow. Bridges have their decks placed 6 in. below grade to allow for the carrying of the macadam surfacing over them.

There are about 150 miles of road in Berrien County, of which 135 miles are of macadam with bituminous carpet. These are generally built by contract and are maintained by the county with state aid. The work is supervised by three county road commissioners appointed for six-year terms by the board of supervisors, and they appoint an engineer. Recently the state has created the position of county superintendent of maintenance, the incumbent, to be appointed by the road commissioners, to be, preferably, an engineer skilled in road work. In addition to the above there is a total of about 50 miles of township road, 40 miles of which are stone macadam. Some of the townships have their own rollers and other complete equipment, and take care of both the construction and maintenance, and, as mentioned above for Benton Township, the roads are frequently used for two years before receiving the bituminous-carpet treatment.

Road maintenance on the intensive or continuous plan, as practiced in Berrien County, is done by traveling gangs, as distinguished from the patrol system. From early spring to late fall the county operates three gangs, one under each of the three commissioners. They travel over routes laid out according to the traffic density and the condition of the roads, looking for and repairing incipient holes, ruts and general wear, and cleaning ditches and drainage structures. In this way heavy, periodical repair work is avoided, and the roads are maintained in good condition. The engineer states that the average cost is $250 per mile per year.

Each gang consists of a foreman and three or four helpers. The plant consists of a motor truck, a 110-gal. heating kettle and the necessary shovels and other tools. The daily pay averages $3.50 for the foreman and $3 for the laborers. The foreman receives daily instructions from the commissioner, and the distances are such that with a 10-hour working day the men can go home at night, riding to and fro on the truck.

How the Repair Work Is Done

When work is begun in the spring, the first thing is to clean out the ditches and culverts and trim the shoulders. Patching of holes and worn spots in the macadam begins with warm weather. Road asphalt, heated to about 300° F., is used for this work. Where the holes appear the surface is loosened with picks, and the dirt and loose material are swept from the road; stone screenings or slag chips are then filled in, hot asphalt or tar is poured over them, and, after a top dressing of screenings has been applied, the patch is tamped to a smooth surface. Unless the patches are large, no attempt is made to keep off the traffic. One gang will patch from one-half mile to two miles of road per day, depending on its condition.

Weekly reports are sent by the foreman to the superintendent of maintenance, who is one of the commissioners. The roads are named and numbered, while each road is divided into lettered sections. The foremen keep account of the labor and material used on each section and enter the figures on their reports; thus the bookkeeper for the commissioners can keep an accurate account for each section.

Maintenance funds for county road work are derived from road rewards and repair rewards paid by the state, supplemented by one-half the automobile license tax of the county. There is also an annual property tax of two mils for road construction and maintenance.

The county road engineer for Berrien County is James Hampton, of St. Joseph. L. Snyder, one of the commissioners, is superintendent of maintenance. The engineer is appointed by the commissioners for a two-year term, and has one office assistant and one field engineer. His main duties are to make surveys, plans and profiles for new roads, and supervise the construction. During the working season he spends about two-thirds of his time supervising the work being done on the roads.

Chicago Union Station to Spend $5,300,000 in 1919

Work Includes Deep Foundations for Head-House, Street-Approach Viaducts and Partial Rearrangement of Tracks

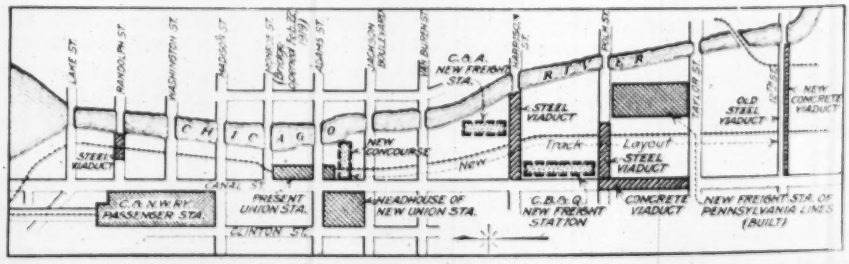
VIADUCTS of steel and reinforced concrete, foundations for head-house and concourse, and construction of a part of the permanent track layout, constitute the principal work to be done this year on the new union station, Chicago. This is estimated to cost $5,300,000 out of the total cost of nearly $60,000,000, which included $30,000,000 for land. The location of this work is shown on the accompanying plan.

Canal St., running parallel with the tracks and along the boundary of the railway property, will be elevated about 10 ft. and from Harrison St. to Taylor St. it will be carried on a viaduct, the space beneath this structure being utilized for tracks. This viaduct will be of reinforced concrete. Its construction this year will be confined to the one block between Taylor and Polk Streets.

Transverse viaducts will extend from Canal St. across the railway property to connect with the river bridges. The 12th St. viaduct will be of reinforced concrete and its south half is to be built this year. Steel will be used for the viaducts at Taylor, Polk, Harrison and Randolph Streets.

At the passenger station, old freight houses between the present station and the river will be torn down, and some of the permanent tracks will be laid in this space, thus increasing the facilities and reducing the present congestion, which results from the limited number of station tracks. Foundations of part of the concourse will be put in at the same time. This concourse will extend between the ends of two groups of stub tracks, which in the new station will take the place of the present through tracks. In other words, the station will be converted from one of the through type to one of a double-end stub type. At the same time it is expected to build four tracks of the permanent six-track approach on the south, extending from the station as far as 12th Street.

Foundations for the head-house can be put in without interfering with existing facilities, as the site is entirely outside of the present station property, and occupies an entire city block. Concrete piers built in wells or open caissons, sunk about 70 ft. to hardpan, will support the steel-frame superstructure. The site was cleared some time ago, and is now being excavated to the basement level, preparatory to sinking the wells.

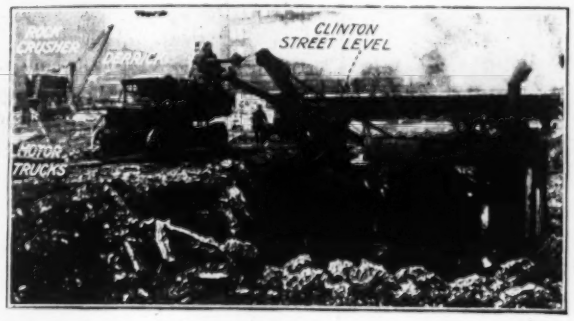


PLAN SHOWS 1919 WORK FOR CHICAGO UNION STATION

Steam shovels are used on this work, useless material being removed in motor trucks, while stone from old footings is crushed and screened on the ground and stored for use in the concrete.

In the steel viaduct construction the steel framing will be covered with concrete or gunite applied by the cement gun over wire mesh wrapping and having a minimum thickness of 1½ in. In general, the design consists of three-post bents carrying cross-girders for a 38-ft. roadway, while cantilever brackets carry 14-ft. sidewalks. Ten lines of plate-girder stringers are framed between the cross-girders, four of the stringers being directly under the rails of the street-car tracks. The roadway deck is a reinforced-concrete slab resting on the steel frame, with wood-block paving laid directly upon this. The 6-in. sidewalk slabs are carried above the girders, being supported by concrete beams at each end.

The bents are spaced longitudinally at varying distances to suit the track layout, and will be embedded



CLEARING SITE FOR HEADHOUSE

in concrete curtains or piers to form a protection against derailed trains. The columns are of H-section, built up of two channels, a web plate and four angles, with batten plates over the flanges of the channels. All viaducts are figured for a live load of two lines of 50-ton street cars on tracks spaced 10 ft. on centers in the middle of the roadway, with 100 lb. per square foot on the unoccupied parts of the roadway and on the sidewalks.

Two-post bents are required at certain points on account of track clearances. In such cases the posts are spaced about 54½ ft. on centers, coming under the sidewalks and carrying heavy cross-girders whose ends have a cantilever projection of 5 ft. 3 in. Where the viaduct is adjacent to the buildings and driveways of the new freight stations, longitudinal expansion joints are provided along the edge of the sidewalk. These are made with deep 1½-in. copper troughs or flashing, filled with asphalt mastic.

All work for the Chicago Union Station Co. is under the direction of Thomas Rodd, chief engineer; J. D'Esposito, assistant chief engineer, and A. J. Hammond, principal assistant engineer. Viaduct designs must be approved by the city authorities. All track work is done by railway forces. Contracts for the 1919 work already let are as follows: Head-house foundations, John Griffith & Sons; steel superstructures for the Polk St. and Taylor St. viaducts, American Bridge Co.; substructure for the Harrison St. viaduct, the W. J. Newman Company.

Other work which is independent of the union station, but is necessitated by the rearrangement of the terminal, includes two large freight stations for the Chicago, Burlington & Quincy R.R. and the Chicago & Alton R.R.

The former station has the foundations partly built, and it is expected that about $3,000,000 will be spent this year on foundation work and superstructure. It is expected also that work will be commenced on the latter station, which is to cost nearly $2,000,000.

Residual Strains in Cast-Iron Car Wheels

DURING the investigation of a railway accident caused by the breakage of a freight-car wheel, the Interstate Commerce Commission recently made measurements of the residual strains in the metal of chilled cast-iron wheels. Relatively high strains were found, of such a nature as to be readily explained by the contraction during cooling in manufacture. In spite of these high strains, the investigation showed that the wheel did not break from internal causes, but was undoubtedly damaged through external violence, probably the impact of a fallen part of the brake rigging, which cracked off part of the wheel flange, this in turn causing the wheel to break apart by its pounding on the rail. Because it represents a further application of the method of studying internal strains which J. E. Howard of the commission's Bureau of Safety has used in rail studies for some years, the investigation is of general value.

Through the cutting rings from a car wheel at six different radial distances from the center, and measuring the shortening of gage-lines on these successive rings, it was found that compressive stresses existed in the rim and the hub of the wheel, and tensile stresses in the web or plate. The hub stresses were high, ranging to more than 25,000 lb. per square inch compression; the rim stresses did not materially exceed 2500 lb. compression. In the plate there were tensile stresses in the neighborhood of 2000 lb. per square inch. These stresses were computed from the measured shortenings and extensions by multiplying by 17,000,000 lb. per square inch, the modulus of elasticity.

While these stresses are of some importance, they are not large enough to suggest danger. In the wheel which broke under the train, moreover, the investigators found clear evidence of the fracture having started at the rim and grown toward the center. There were no defects in the fracture, and the rim of the wheel showed no burned or otherwise damaged spots. The wheel had been in service only two months, having been placed on the axle in December, 1916. It broke while running in a New York Central freight train near Waterloo, Ind., on March 25, 1917. It was evident that the fracturing process had proceeded rather slowly after the piece of flange was broken off; the train ran nearly 1000 ft. before the last fragment of the wheel left the axle. While no direct proof was obtainable that a piece of the brake rigging started the breakage, the commission's report, published in a bulletin just issued, states that no other explanation of the facts of the accident was found to be tenable.

Move Bridge Spans 136 Feet Endwise on Car Trucks

Two Lines of Steel Trucks on Falsework Carry Hydraulic Jacks Which Raise Three Spans Together and Support Them While Hauled by Cables

RECONSTRUCTION of the combined railway and highway bridge of the Union Pacific Ry. across the Missouri River at St. Joseph, Mo., in 1917-18, included as its principal features the building of new piers, the shifting of three 300-ft. truss spans longitudinally into new position, and the building of a new drawspan. The bridge had to be kept in service during the work, except for the short time required to shift the spans. Traffic averaged about 75 trains and 400 teams and automobiles daily. River traffic also had to be provided for until the close of the navigation season. Indications of weakness in the old piers having made a new substructure necessary, it was proposed to build new piers on the downstream side and move the bridge laterally into its new position. The War Department, however, required that in connection with the alterations a longer drawspan should be provided. This new condition led to the plan of locating the new piers between the old ones and moving the spans longitudinally into position. The superstructure work included the following, in the order given; Rolling three spans lengthwise; building a new 465-ft. swing span; rolling an 80-ft. girder span lengthwise 28 ft. and building a new 60-ft. girder approach span; removing the old 358-ft. swing span. The alignment is straight and unchanged, but the new rail level is 18 in. higher than the original. Construction of the new piers was described in *Engineering News-Record* of Oct. 25, 1917, p. 781, while the moving of the fixed spans was noted in the issue of Nov. 22, 1917, p. 989.

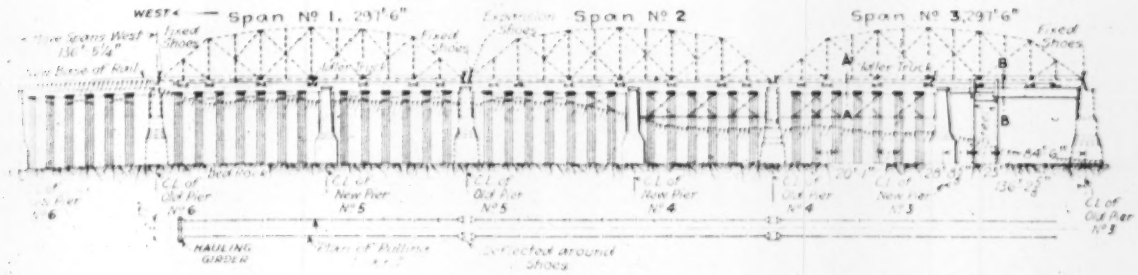
BRIDGE SPANS ARE HAULED BY CABLES

After the new piers had been built, the first stage of work on the superstructure was the shifting of the three through spans of 300 ft. each. This consisted in moving them 136 ft., to land them on the new piers. They have trusses of the Pettit type, 50 ft. high and spaced 17 ft. on centers, with a single track between them. Floorbeam brackets 48 ft. long carry 15-ft. roadways outside of the trusses.

Car trucks traveling on falsework and carrying hydraulic jacks were used for moving the 300-ft. spans. They were mounted on two tracks directly under the trusses, with the jacks at the panel points. There were 14 trucks to each span, but the two under the middle panel points carried only blocking, which was built up close to but not in contact with the trusses. This arrangement provided a rigid support in case failure of any one jack should throw excessive load on the other jacks. Semicircular shims were built up around the plunger of each jack and kept within a short distance of the plunger head, so that in case of loss of pressure or the failure of a jack while the bridge was being moved the span would come to a solid bearing with very slight settlement. No such failure occurred, however. For operation the jacks were arranged in two groups, each with its own steam pump, this arrangement being necessitated by the difference in the diameters of the jack plungers. For the west span there was a group of 12 jacks of 500-ton capacity with 12½-in. plungers. The other two spans had a group of 24 jacks of 300-ton capacity with 10-in. plungers. All jacks had strokes of 9 in. The heavier jacks were used because they were on hand. The average load on the jacks being only about 70 tons, the pressure on the jacks, piping and pumps was only 2500 lb., while the capacity pressure was 10,000 pounds.

To equalize the load on the jacks, every jack in each group was connected by ½-in. flexible copper tubing to a pressure line of ¾-in. extra-strong steel pipe with forged fittings. The steel pipes were laid on the floor beams, outside of the track ties. A shut-off valve and bleeder valve were placed at each connection to these pipes, for convenience in changing the packing if leaks should develop, but this precaution was not required.

A denatured alcohol mixture was used in the jacks on account of the cold weather, about 400 gal. being sufficient for the raising of the spans 30 in. by the 36 jacks.



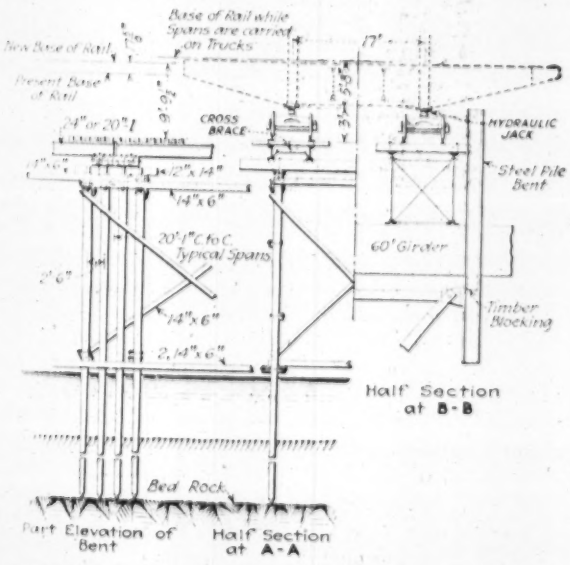
THREE 300-FOOT BRIDGE SPANS ARE MOUNTED ON TRUCKS AND SHIFTED 136 FEET TO NEW PIERS

and then for supplying them during the moving of the spans. Readings were taken at regular intervals. Static loads registered 1700 and 2200 lb. per square inch for the 500-ton and 300-ton jacks respectively, these readings being taken after the pumps were shut down. Surge loads, with the pumps in action, registered from 2300 to 2500 lb. per square inch for the heavier and 2700 to 2800 lb. for the lighter jacks.

Maximum working load for the 300-ton jacks was calculated at 2450 lb. per square inch, which was taken as the static load after the bridge was raised and the pumps were stopped. Raising the bridge 18 in. to its new grade was done with eight jacks per span. These were placed on the piers and operated gradually between trains, so as to maintain the proper run-off or incline in track on the fixed spans and the swing span. This jacking extended over a period of several days.

The falsework for the rolling track consisted of piles supporting 24-in. I-beam stringers, except that an 80-ft. girder span was used at the east end, where the water was deep and swift. Framed bents were seated on the footings of the old and the new piers, being secured by cables and fox bolts. Piles were arranged in two rows, one outside each line of trusses. They were in groups of four, those of each group spaced 30 in. on centers while the groups were 20 ft. on centers, connected by horizontal and diagonal bracing in two directions.

At each group, four cross caps carried a 12-ft. longitudinal cap, and across the latter were placed nine 30-ft. timbers 8 x 17 in. These were laid solid to form a bearing for the I-beam stringers, which were in pairs, with riveted connections between the webs. Across them were the 8 x 8-in. ties, 4 in. apart, to which were spiked the 75-lb. track rails.

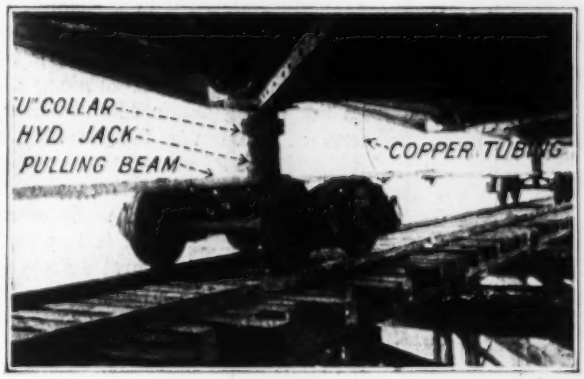


FALSEWORK CARRIES TWO LINES OF TRACKS WITH HYDRAULIC JACKS UNDER THE BRIDGE CHORDS

Piles were of longleaf yellow pine, 40 to 70 ft. long, driven to rock or to absolute refusal, and having an average penetration of 25 to 30 ft. They were driven by a steam pile-hammer in swinging leads which were suspended either from the boom of a locomotive crane or from the projecting ends of a heavy timber laid across the top chords of the trusses.

Steel trucks used for rolling the spans were of the standard type for 50-ton freight cars. They had cast-steel frames and bolsters and were rated at 160-ton capacity. The jack on each truck was seated over the king-pin and anchored rigidly by bolts passing through the flanges of its base and through timber blocks inserted in openings in the bolster. To provide against failure of some detail part every truck was tested to 100-ton load at the site, a special testing frame equipped with hydraulic jacks being constructed for this purpose.

A rigid pulling beam connected the 21 trucks on each side, this beam being composed of a pair of angles



CAR TRUCKS WITH HYDRAULIC JACKS MOVE SPANS

bolted to plates which fitted over the heads of the king-pins of the trucks. The upstanding legs of the angles were cut away to admit of seating the base of the jack on the truck bolster.

Across the forward end of the two front trucks was a girder composed of a pair of heavy I-beams laid flat and connected to the two pulling beams. To this girder were attached the blocks of the hauling tackles. To transmit the pull from the girder directly to the spans as well as to the trucks, steel cables were run from the girder to one of the floor-beams of the first span, these lines being drawn tight by steamboat ratchets.

Hook bolts held the end shoes to the trusses when the spans were raised.

The hauling was done by four sets of 4-sheave blocks, each rove up with a nine-part tackle of 1½-in. manila rope. Two of these sets were handled by an 85-hp. steam hoist and the other by a 200-hp. electric hoist, these hoists being placed just back of the new west abutment. The load pulled was about 2760 tons, including the three spans, 42 trucks, 36 jacks and the pulling attachments. Of this total, the three spans represented 2520 tons.

Preparations for moving the spans were begun in August. Traffic was not interrupted until the day of the moving, Nov. 14, when the railway and the highway were closed from 8 a.m. to 5:40 p.m. The rolling of the spans a distance of 136 ft. consumed only 13 min., the remainder of the time being occupied in getting ready and in closing the 136-ft. gap left at the east end. For this latter purpose pony bents were set on blocking on the falsework used for the rolling tracks. These carried timber stringers for the track and roadway decks. Construction of the new drawspan, which was done while keeping the bridge open for traffic, will be the subject of a separate article.

The above work was done for the St. Joseph & Grand Island Railway Co., under the direction of R. L. Huntley, chief engineer of the Union Pacific System, with H. M. Stone as resident engineer, the entire project being under the general supervision of E. E. Adams, consulting engineer of the Union Pacific System. The American Bridge Co. was the contractor, and the work was carried on under the personal supervision of K. L. Strickland, division erecting manager, T. S. Melton, foreman, and A. F. McLane, resident engineer.

Transverse Fissures in Rails and Phosphorus Segregation

Longitudinal Streaks Attributed to Phosphorus Are Found at Nucleus of Rail Fracture by Copper-Chloride Etching

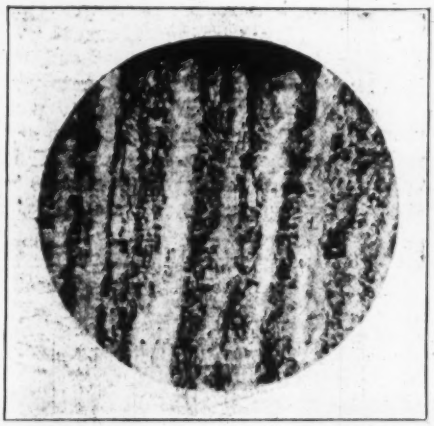
NEW micrographic studies of broken rails have recently led G. F. Comstock, metallographist of the Titanium Alloy Manufacturing Co., Niagara Falls, N. Y., to suggest an explanation of transverse fissures that in a measure bridges the gap between the opposing views current for some years past. According to his findings, brittle streaks of high-phosphorus steel in the rail head constitute the initial weakness from which a transverse fissure starts.

J. E. Howard, of the Interstate Commerce Commission's Bureau of Safety, has maintained that excessive stress in service in the track is responsible for transverse fissures, and that the only cure is the adoption of a heavier rail section. His experimental proof of high residual stresses in the center of the rail head, and his discovery of large compressive stress along the running surface from the rolling action of the wheels, which shifts the zone of maximum tension to the interior of the head and adds the effects of service stress and residual stress, supported the overstress theory. Transverse fissures are generally conceded to be detail or "fatigue" fractures, but in most cases it has been impossible to discover chemical or structural defects in the steel at the center or nucleus of these fractures, so that it seemed necessary to conclude that overstress initiated the fracture.

Railway men, on the other hand, adhered to the belief that defective quality of rail steel is at the root of the fissure trouble. Mr. Comstock presents evidence of a minute defect at the nucleus of transverse fissures, namely, streaks of steel abnormally high in phosphorus content. He has concluded that the initial crack or check in the rail head occurs in such a brittle streak and that progressive detail fracture follows. Further, he found from the records of 36 rails that long soaking of the steel in the furnace before rolling prevents fissuring, presumably by allowing the phosphorus to diffuse through the mass, and thus preventing the formation of the brittle streaks. This fact, if confirmed, provides a method of combating the fissure trouble in rails.

In these investigations, failed rails were sawed apart longitudinally at the fracture, and the surfaces so prepared were polished and then were etched with copper chloride. This reagent deposits a film of copper on normal steel, while certain special constituents, among them steel of high phosphorus content, remains bright. The inverse effect could be obtained by picric-acid etching, which darkens high-phosphorus areas.

A typical microphotograph of such an etched section is reproduced herewith, from an illustration in a paper read by Mr. Comstock before the American Institute of



HIGH-PHOSPHORUS STREAKS IN LONGITUDINAL SECTION OF RAIL AT TRANSVERSE FISSURE, ETCHED WITH COPPER CHLORIDE (× 16)

Mining Engineers at its annual meeting, Feb. 19, 1919, under the title "Metallographic Investigation of Transverse-Fissure Rails with Special Reference to High-Phosphorus Streaks." The broken line near the top of the picture is the face of a transverse fissure. The light bands extending vertically are believed to be high-phosphorus streaks. A prominent streak extends directly to the point where the nucleus of the transverse fissure was located. Closely similar conditions were found in many other rails that had failed by fissure.

Studying all the available rail material—namely, 24 transverse-fissure rails and 12 good rails—all were graded for various different defects in steel quality, including segregation (as shown by sulphur print), presence of slag and similar impurities, segregation of

...des, amount of free ferrite, amount of cementite, ... finally phosphorus streaking. It appeared that no ... differences of grading between the failed rails ... good rails appeared under any head except that of ...sphorus streaks, and under this latter head the ...ority of the transverse fissure rails were unsatis...tory, while the majority of the good rails were ...ntly above average quality.

Taking this as indicating the causal relation between the high-phosphorus streaks and fissuring, Mr. Comstock studied the same rails as to origin. So far as data could be obtained, it was found that all the failed rails had been rolled direct from the ingot, while all but two of the good rails had been rolled from reheated blooms. Since the length of time the ingot is hot suffices for carbon diffusion but probably not for phosphorus diffusion, this result appears to confirm the conclusion reached.

Concrete Is Handled in Several Ways on Bridge Abutment Job

HOPPER cars, derrick skips, elevator buckets and inclined chutes were combined in placing 3360 cu.yd. of concrete in abutments and approach retaining walls for a steel highway bridge across the Chicago & Northwestern Ry. at Wheaton, Ill. To give increased headway the bridge is at a higher elevation than the old span parallel to it, so that long inclined approaches were required, practically at right angles to the bridge, as shown by the accompanying plan. Each approach has a retaining wall on one side, and the wall on the south side of the railway is 600 ft. long.

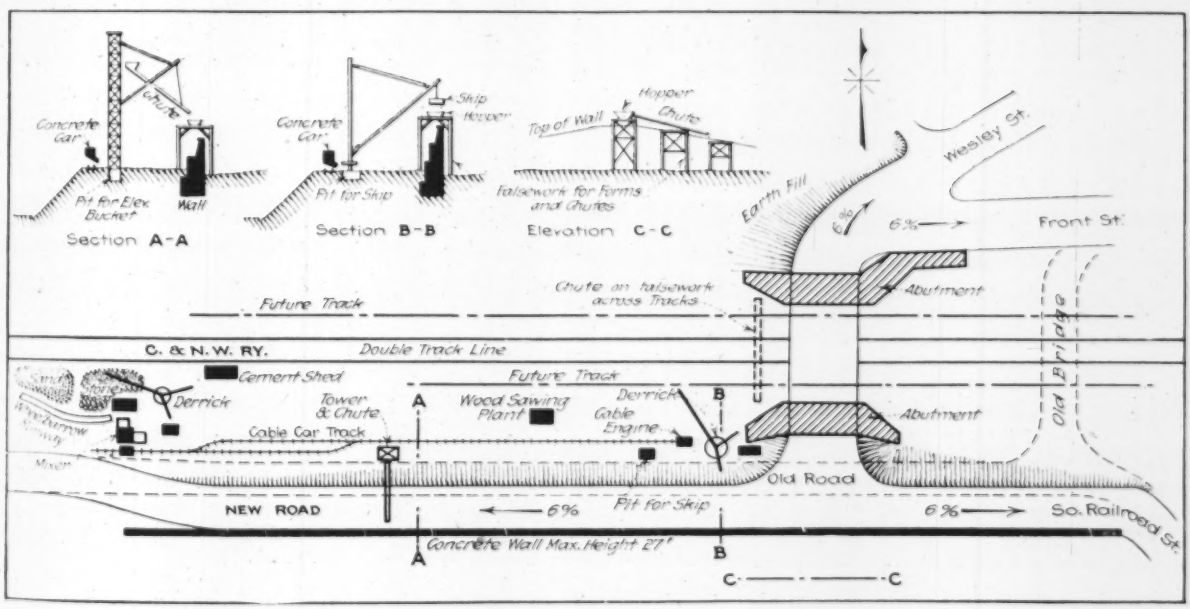
A concrete-mixing plant was located beyond the end of the cut. Sand and gravel were unloaded from cars into stock piles on the side of the adjacent fill, and the stone was loaded into an elevated bin by a derrick with a grab-bucket. The sand was wheeled to the loading chute. The mixer discharged the concrete into a side-gate hopper car.

Between this plant and the bridge site an elevator tower with a chute was erected, while beyond this and close to the abutment was a guyed derrick, both tower and derrick being on the narrow strip between the old road and the top of the cut. A narrow-gage track with one automatic siding extended from the mixer plant to the tower and derrick. This was operated by an endless cable with a hoisting engine placed near the derrick, and on it the concrete was handled in the hopper cars mentioned above.

At first the concrete was delivered to the elevator bucket and spouted to the forms. The tower chute or spout extended across the road and delivered the concrete into lateral chutes supported directly above the forms by falsework. This sufficed for about half the length of the wall.

For the remainder of the work the cars ran up to the derrick and discharged the concrete into a home-made wooden skip which was placed in a pit at the side of the cable track and was handled by the derrick. A movable gate was fitted to one end of the skip, with inclined boards on the inside to guide the concrete to the opening and prevent it from being pocketed in the corners. The skip was dumped into a feed hopper at the summit of inclined chutes carried along and above the forms for falsework.

Concrete for the abutment on this side of the railway was placed directly by the derrick and skip. For the abutment and short wall on the opposite side an inclined chute was extended across the tracks, having a feed hopper at its upper end within reach of the derrick. At its lower end was a vertical drop pipe leading to the head of the chutes over the abutment form, these being



LAYOUT OF CONCRETING PLANT FOR BRIDGE ABUTMENTS AND RETAINING WALL

shifted to deliver the concrete in the desired portions of the form.

Baffles were used at the discharge ends of the long chutes to prevent segregation of the concrete as it was deposited in place. In some cases these were short troughs secured to the trench bracing or form struts, being placed opposite the end of the chute and sloping in the opposite direction, so that the direction of the concrete was reversed just before its final discharge.

This work was done by the Widell Co., Mankato, Minn., under the general direction of O. F. Dalstrom, engineer of bridges, Chicago & Northwestern Railway.

Approximate Formulas Useful in Structural Design

A Few Serve Well When Handbooks Are Not Available—Limits of Reliability, However, Should Be Well Understood

By R. Fleming
American Bridge Co., New York City

FREQUENTLY the designer of steel structures is called upon for information when handbooks and textbooks are not at hand. It is surprising how much may be furnished at such times with a few well chosen approximate formulas. Some approximations are suggested. It is essential, however, that before they are used they be tried out and their degree of approximation well understood.

Radii of Gyration—If d = depth and b = breadth of section, for standard I-beams the radius of gyration, r, = $0.375d$ and $0.20b$. For Bethlehem girder beams $r = 0.42d$ and $0.23b$. In standard I-beams the breadth varies from 55% of the depth for a 6-in. I 12.25 lb. to 29% for a 24-in. I 80 lb. In Bethlehem girder beams the breadth varies from 100% of the depth for an 8-in. I 32.5 lb. to 50% for a 30-in. I 200 lb.

For equal-leg angles $r = 0.3$ of the width of leg when the neutral axis is parallel to either leg. For unequal leg angles $r = 0.3$ of the width of the leg to which the neutral axis is at right angles.

For well-designed columns, if of four angles latticed, $r = 0.4d$ and $0.2b$. If of one plate and four angles, $r = 0.375d$ and $0.2b$. If of one plate, four angles and two cover plates, $r = 0.4d$ and $0.25b$. If of 2 channels latticed, $r = 0.35d$ and 0.6 of the distance back to back of channels when this distance is not less than 0.6 the depth of channels used. If of 2 channels and 2 cover plates $r = 0.4d$ and $0.3b$. (In this connection see an article, "Approximate Radii of Gyration," by O. von Voigtlander, in *Engineering News* of May 23, 1912, p. 991.)

Section Moduli—If W = weight of beam per linear foot, and d = depth; for standard beams 10 in. or less in depth the section modulus, S, = $Wd/10$; for standard beams deeper than 10 in., $S = Wd/11$; for Bethlehem girder beams, $S = Wd/10$.

Safe Load in thousands of pounds for standard beams equals weight of beam per linear foot multiplied by depth in inches and divided by span in feet. (See an article, "Approximate Design in Structural Steel," by George A. Merrill, in *Engineering News* of Mar. 21, 1912, p. 540.) It may be noted that for a uniform load, $M = WL/8$; for a concentrated load $\frac{1}{2}W$ at center of span, $M = WL/8$; for two concentrated loads of $\frac{1}{3}W$ at the third points, $M = WL/9$; for three concentrated loads of $\frac{1}{4}W$ at the quarter points, $M = WL/8$, and for four concentrated loads of $\frac{1}{5}W$ at the fifth points, $M = 3WL/25$.

Area of Cross Section in square inches of all steel sections is 0.3 weight per linear foot. (Error 2%.)

Weight in pounds per linear foot of all steel sections is $3\frac{1}{3}$ times area of cross section in square inches. (Error 2%.)

Weight of Angles—Derive the weight of an angle from the cross-sectional area of a plate having the same thickness as the angle and a width equal to the sum of the legs.

Weight of Roof Trusses—The many empirical formulas that have been given for determining the weights of roof trusses fail to take into account so many varying factors that their usefulness is very limited. It is better to make deductions from the known weights of a few trusses than from inadequate formulas. The estimated weights of a series of Fink trusses for a roof sloping 6 in. per foot, carrying a uniformly distributed load of 800 lb. per linear foot of top chord, for spans of 30, 40, 50, 60, 70 and 80 ft., are 1000, 1700, 2400, 3200, 4400 and 5600 lb., respectively. Warren trusses, for a roof sloping 1 in. per foot, and for the same load and spans, weigh approximately 1200, 1800, 2700, 3400, 4600 and 6100 lb., respectively. The weight of details in ordinary roof trusses is from one-tenth to one-sixth of the total weight. This is equivalent to an addition of from 11 to 20% to the weights of main members.

Weight of Columns is approximately weight of main material, or stem of the column, plus 20% for details. The theoretical weight per linear foot of the stem of a column in a many-storied building is approximately $\frac{\text{Load in pounds}}{12{,}000} \times \frac{10}{3}$. In determining the total weight, 25% of this should be added for details and excess of actual over theoretical section. As columns are usually fabricated in two-story lengths, the load on the lower-story portion should be used for the whole length.

Weight of Plate Girders is weight of web plate and flanges plus 20% for details. Plate girders may be approximately designed by considering the depth of web plate to be the depth of girder and neglecting the $\frac{1}{8}$ web area in proportioning the flanges.

Weights of Buildings—No reliable formula can be evolved for the weight of structural steel in buildings. Neither should the weight per square foot of area nor cubic foot of volume of a structure already built be assumed as the weight of a proposed structure, unless the conditions which govern the one are found in the other. The trusses, purlins and bracing of a roof covered with corrugated metal usually weigh from 5 to 8 lb. per square foot of ground area. In a one-story building, with both siding and covering of corrugated metal, and without traveling cranes, the weight of structural steel will average between 10 and 15 lb. per square foot. Plank, tile or concrete covering will add to this weight 2 or 3 lb. per square foot. If traveling cranes are used the weight will be increased from 2 to 5 lb. per square foot.

Floors in mill buildings vary from 10 lb. per square

foot for the floor of a light machine shop to 40 lb. for a heavy charging floor in a foundry.

Office buildings not more than 12 stories high in which the exterior walls are carried by steel framing will average about 1.9 lb. per cubic foot of volume; hotels and apartment houses about 1.5 per cubic foot of volume.

SOCIETY SERVICE

A Section Dealing with the Results of Teamwork by Technical Men

Engineers to Educate the Public

On the bottom of the stationery of the Iowa Engineering Society is the slogan "Write; talk; why not? It will help. Consult the committee on publicity." Iowa is in need of more good engineers than ever before, for she is on the eve of an immense road-building program. The society realizes that engineers in the war have made a lasting impression on the layman by doing the "far-off" task in winning the war, but real work is at hand to educate the home folk that engineering of even greater importance exists right at home.

An Example of Society Disservice

An illustration of the sort of professional friendship which engineers sometimes show to one another was recently given at Cheyenne. The Wyoming Society of Engineers, at the close of a two-day meeting, gave a dinner and held an informal meeting at the Plains Hotel on the evening of Jan. 28.

There were at the hotel at that time five engineers from various states, all of whom have been identified with Government work in Wyoming. The State Engineer, who is a prominent member of the state society, invited the visiting engineers to attend the after-dinner meeting. The invitation was later recalled, with sincere regrets on the part of the State Engineer, because some of the society members objected to having outsiders among them.

Such an incident seems incredible, but it is reported on good authority.

State Society Issues Bulletins to Members

As attendance at annual meetings of the Illinois Society of Engineers averages only 20 to 30% of the total membership, the society has issued a bulletin giving a summary of the proceedings of its recent meeting, with new officers elected, resolutions passed, etc. In this way absent members are informed as to the doings of the society. Similar bulletins are issued during the year, giving information as to the society's activities, important legislation, public meetings relative to engineering, and other matters of interest, thus keeping the members in touch with the society's work and engineering developments in general and involving no great expense. This is of particular advantage in regard to members in rural districts, who usually have little opportunity of obtaining information of this kind.

As a refutation of the argument that resolutions do no good, this society has the pleasure at least of seeing some Chicago newspapers mention it as among the indorsers of the new Illinois housing bill, which aims at rigid control of future building construction.

LETTERS TO THE EDITOR

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

Why Not Engineers for Federal Rural Health-Protective Work?

Sir—In your issue of Feb. 13 you review the bill introduced in Congress by Mr. Lever, to provide means for the control and mitigation of the diseases of our people living in the country and in towns of not more than 5000 persons. You say that "the United States Public Health Service is designated as the agency of the Federal Government in the work, and the states to be represented by their health department or officers." This puts the work into the hands of the doctors and absolutely cuts out the engineers, particularly in this State of New York, where engineers are not eligible as health officers. Now, the duties contemplated by this bill are such as belong to the sanitary engineer and for which very few doctors are qualified. Why is not this a case where the interests of the engineering profession should be looked after and an engineering board be made the agent of both Federal and State Governments?

H. C. HODGKINS.

Syracuse, N. Y.

Ignoring Findings of Board of Engineers on Deep Waterways

Sir—Along with many others, I am wondering why Congress is passing a bill for studies of a deep waterway canal from the Great Lakes to Atlantic tidewater, and whether it is possible that the very thorough and conclusive report in the year 1900 by the Board of Engineers on Deep Waterways between the Great Lakes is so soon forgotten. This board, authorized by Congress, had as its members C. W. Raymond, colonel of engineers; Alfred Noble and George Y. Wisner. Their study and report were an elaboration of the work of the United States Deep Waterway Commission of 1897, of which James B. Angell, John E. Russell and Lyman E. Cooley were members. The board of 1900, after thorough studies of a 21-ft. and a 30-ft. channel over various possible routes, recommended a 21-ft. canal via the Lake Ontario, Oswego, Mohawk Valley, Hudson River route, at a cost of $206,358,000.

Their advice was ignored by New York State for a barge canal limited to 12-ft. depth over the lock sills, because of the opposition of the Cities of Buffalo and New York to any canal that would give through service and thus avoid their rake-off in terminal charges. It would now seem just retribution for an economic crime if the United States should build a canal for ocean steamships to protect the Central West against this extortion mentioned in the recent debate in Congress. The New York Barge Canal, conceived with such a

purposes and in defiance of economic principle, was doomed to failure as a financial burden.

Unfortunately, it is not generally known that small oceangoing steamers have for many years been going direct to the Great Lakes up the St. Lawrence River and the Lachine and Welland Canals of Canada, in spite of the statement of Lewis Nixon, superintendent of public works for New York state, that such a route would be impracticable. This information was very definitely brought to the writer's attention in 1903 while making the preliminary engineering studies for the railroad crossing at Detroit, when a record was kept of the characteristics of all steamers using Detroit River.

Your comments on the above would undoubtedly be much appreciated.

BOYD EHLE,
Tulsa, Okla. Mem. Am. Soc. C. E.

Possibilities of the Fabricated Ship

Sir—I was very much interested in the editorial on the fabricated ship printed in your issue of Feb. 20. This is timely and appropriate, and the argument is sound.

As the fabricated ship yards were built and operated under abnormal conditions, the data as to time required for assembling steel of hulls and the cost cannot be used as a basis of comparison with the records in the old, established yards. There is little doubt, however, that under normal conditions the fabricated ship will be a real competitor. While the method involves extra handling of material, this handicap should be more than offset by the advantage of quantity fabrication of each item. The great importance of this principle in shop management is well known.

L. G. FISHACH.
Leetsdale, Penn.

Guarantee Profit Sharing by Law

Sir—*Engineering News-Record* at different times since the entrance of the United States into the great war has published editorials setting forth the idea that the war marked the passing of the old and the ushering in of a new order in our social relations.

There is a general call for fair dealing; a call for the employer to treat the employed as he would be treated were their positions reversed; a call for profit sharing and the apportioning of dividends.

This is good, but not sufficient. The employee should not, in so fundamental a matter, be left to the nobler sentiments or higher aspirations of his employer, be he ever so highminded, for many there are who will not be so animated. Capitalists do not so trust their wealth to other capitalists. Their every interest is safeguarded by all the legal guarantees that it has been possible for able jurists to devise.

Cannot some similar legislation be worked out to guarantee to the man in the ranks a fair share in the profits in the making of which his industry has contributed so material a part? Here is a plan, and it might be styled "An Act to Compel Profit Sharing and to Regulate the Same."

The United States Government now demands an accounting from every corporation, and appropriates to itself as "excess profits" a certain portion of the income above a stipulated return on the investment. This law might well be repealed, or amended to operate [illegible] larger income had been allowed, and in its place legislation enacted that would demand an accounting [illegible] present, but providing that the profits above a [illegible] stipulated return shall be divided in a certain fixed and graduated ratio between the employer and each employee. Similar legislation would necessarily have to be enacted by the various states.

By this it is not intended that every individual who works a day here or a day there will, at the end of the year, draw "dividends" from a half dozen different concerns. That can all be regulated so that an employee will not become a "stockholder," or "member of the firm" until he shall have worked a month, or two or three months, as experience with the plan may indicate to be best, and varied to suit different industries. At first it might possibly best be limited to manufacturing plants, continuing industries, and transportation, but as rapidly as possible it should be extended so as to include, in the end, practically all activities.

The directing of the work, except in the matter of employing and discharging men, in which a committee of the employees should have the right of review, in the future as in the past should be in the hands of the owners. Some may object to this, and argue that the employee should have a hand in the managing of affairs. As a matter of fact, he would have. For as time went on the competent employee, as opportunity offered, would withdraw his "capital"—that is, his "labor"—from the concern paying small dividends and place it with the concern paying large.

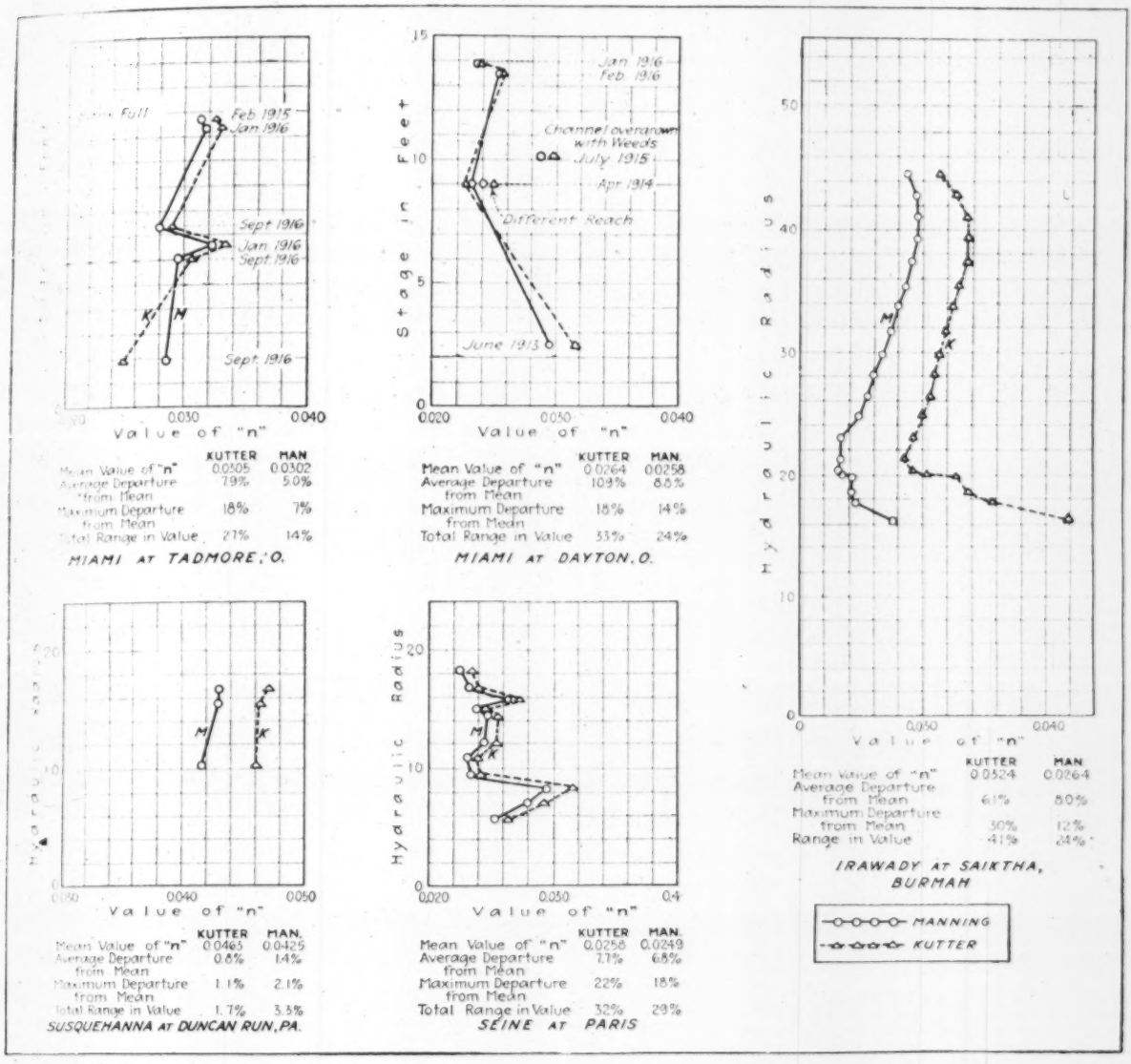
The engineers of the country represent trained intellects; to them more than to any other class has been due the wonderful progress in invention and industry, resulting in enormous increase in material wealth. With them rests in great measure the working out of measures that will make all this material progress work to the advancement of mankind.

H. A. RANDS.
Portland, Ore.

Variation of Roughness Coefficient in Manning and Kutter Formulas

Sir—Robert E. Horton's review of Ivan E. Houk's excellent report on the "Calculation of Flow in Open Channels," in *Engineering News-Record* of Jan. 20, 1919, p. 149, prompts the following remarks concerning the relative variability of the roughness coefficients in the Manning and Kutter formulas. These two formulas are compared in Mr. Houk's report, and while the report is especially commendable because of the unprejudiced care with which different formulas are compared, the writer believes that Manning's formula has not received quite all of the credit to which it is entitled. The writer is strongly in favor of this formula as against the more complicated Kutter formula, not only because of its much greater simplicity, but also because the use of Kutter's n in this formula gives results practically identical in a large percentage of cases with those found by using the Kutter formula with the same value of n. This is well shown by a comparison of the two in over 250 experiments listed in King's "Handbook of Hydraulics," which Mr. Horton mentions.

In applying either of these formulas to natural streams, however, a question that has troubled the writer on several occasions is the question of the



DIAGRAMS SHOWING VARIATION OF KUTTER'S AND MANNING'S *n* WITH CHANGE IN RIVER STAGE

variation of *n* with change in the stage of the stream. Having assumed or determined by actual measurement the value of *n* at some given stage of a certain stream under investigation, can this same coefficient be used for others stages of the stream, and, if not, what will be the direction and probable amount of the departure from this known value? To answer this question in a small way, the writer plotted corresponding values of Kutter's *n* and Manning's *n* for various stages for a few of the streams on which the experimental data cover a fairly wide range in stage. The few examples presented above do not include all of the available material by any means, although it may be noted in this connection that experiments on natural channels which cover a large range in stage are not plentiful. Of those which do exist, not all can be used, because some minor change in conditions during the series introduces a disturbing factor which renders comparison of the different experiments uncertain.

The five examples given cover a wide range in natural channel conditions. Of these the series on the Miami River at Tadmore seem to the writer to deserve the greatest weight. Conditions on the reach selected were very favorable to good results, and the work appears to have been carefully done in all respects. The experiments cover the entire range from low water to bank-full stage. Zero of the gage is apparently about a foot above the stage of no flow. The work on the same stream at Dayton does not seem to have been done under such favorable circumstances, as the condition of the channel was not the same in all experiments. These experiments do not cover such a wide range in stage as those at Tadmore. Zero of the gage is probably about 5 ft. above the stage of no flow, while bank-full stage is given as 18.0 in the Weather Bureau description of the gage. In the other three examples given, it was necessary to plot *n* against the hydraulic radius, as the stage was not given. This,

however, closely indicates the change with stage. The Susquehanna experiments made at McCall's Ferry by Anderson, when compared with the Miami work, are only fair. The fourth experiment was not plotted, as a different section from that used in the first three was taken. The Irawady and Seine experiments are taken from Hering and Trautwine's translation of Kutter and are given because of the wide range in the value of r which the experiments cover. The original data on these experiments were not available to the writer, and therefore he could not form a personal opinion as to their relative weight. He well recognizes the danger of blindly presenting data without a careful examination of the original material, for often in abridging experiments for quotation the facts essential to a proper comparison of the experiments are of necessity omitted.

In referring to the diagrams, it should be noted that the lines joining the plotted points are for the purpose of bringing out their relationship, and they do not indicate values of n for intermediate stages between the points. The variability in each series is shown by the maximum, average, and range of departure of the individual points from the mean value for the series. These are expressed as a percentage of the mean value.

The results on the diagrams indicate—at least for these few streams—a greater stability on the part of Manning's n than is shown in Kutter's. It shows less variation as the stage changes and can, therefore, be used with greater reliance over a range of stage. Needless to say, the coefficient which comes the nearest to remaining constant over a range of stage is the more desirable, and Manning's n shows this property to a greater extent than Kutter's. Aside from the question of variation, it will be seen that the absolute values of the two n's are not widely different, both lying within the range of values commonly considered in connection with natural streams. The random assumption of some value of n for a given stream is at best subject to more or less doubt. A single experiment on the stream is much to be preferred, and the data obtained in this way is as easily reduced to Manning's as to Kutter's n. The engineer then has a coefficient which he can apply with greater assurance to a greater range in stage than he would be justified in doing with Kutter's n.

H. R. LEACH.

Saginaw, Mich.

[On Mr. Leach's comments Mr. Horton writes as follows:—EDITOR.]

Sir—Mr. Leach calls attention to an important matter in relation to river hydraulics.

While his conclusion is undoubtedly correct, that the formula which gives the least variation of coefficient with varying stage is, other things being equal, the one to be preferred, yet it seems desirable to go a little farther and call attention to the fact that the coefficient of roughness in these and other similar formulas includes some things beside the effect of roughness itself.

The coefficient of roughness as ordinarily determined, especially in the case of low water on streams, includes ineffective fall and ineffective cross-section as well as roughness. At flood stages of a stream, practically the total fall and the total cross-section in a stream of even quite irregular channel width and depth are effective in producing velocity and transporting water. At low stages a considerable part of the fall may be lost in ripples and eddies, and if there are deep pools, numerous bends or wide shallow reaches there may be stagnant water, and the portion of the cross-section which it occupies, if included in the measured cross-sections used in calculating the coefficient of roughness, will result in an apparent coefficient of roughness larger than that for the same stream at higher stages.

The writer has seen instances where the banks of a stream were unquestionably rougher than the bed, and yet the coefficient of roughness almost invariably decreased as the stream stage increased, the coefficient being calculated, as is the usual practice, from the actual cross-section and measured slope, whether effective or not. This simply emphasizes the fact that slope formulas, like most other engineering methods, are neither automatic in their operation nor fool-proof.

In general, if a coefficient of roughness has been determined at a certain stage of a stream, its value should be somewhat decreased when applied to higher stages, and increased when applied to lower stages.

Mr. Leach's letter gives some valuable information indicative of the character and amount of the change in coefficient of roughness with changing stage.

Albany, N. Y. ROBERT E. HORTON.

Utilize the Topical Index for Reference

Sir—Your average reader probably observes the topical index on the front page for the purpose of noting the articles pertinent to his particular line of work, and then forgets it. It has been my practice to utilize this topical index in a very concrete manner by clipping the items in which I am more particularly interested, and pasting the same on a 3 x 5 card. This card is filed in a suitable card index file, which is kept on my desk for immediate reference. After the article is read carefully it is readily referred to at any future time by inspection of my card index.

In this manner I have a working index to the live articles published weekly in *Engineering News-Record*, and it is not a study to remember where and in which number a desired article is published.

F. L. BIXBY,

Reno, Nev. Senior Irrigation Engineer.

Locations for Improved Public Highways

Sir—From *Engineering News-Record* of Dec. 19, 1918, just received, I am pleased to learn of the extensive interest being shown in the United States in permanent good roads.

Having had many years of road experience both as engineer and contractor in New York State and New England, in addition to nearly a year of road work with the A. E. F., I venture to suggest that when permanent roads are constructed they be built on permanent locations. By permanent locations I mean those that will not necessitate change through any condition now foreseen. Make the location as well as the road surface permanent.

Trucks will be the most important users of good highways. Experience here and elsewhere has proved to my satisfaction that grades requiring a loaded truck to go into intermediate gear, or curves that require a material reduction of speed, are much more serious matters than I had previously believed. The capacity of an otherwise good road under heavy summer traffic

is materially decreased by even one grade requiring the use of intermediate gear, and that capacity suffers a further very material decrease during periods when snow and ice are encountered.

Location is part of the road, and a good location is an absolute necessity in order to get 100% efficiency from any given road surface. The better the surface, the more important the location. The saving in maintenance charges by a proper location, together with the saving in operating expenses of motor vehicles, will be of benefit to all generations, including the present, which must soon decide the question of permanent locations. The cost of a proper location is as proper a charge against the total cost of a permanent highway as the cost of right-of-way is against the cost of a railroad.

I believe that in many cases it is not economy to build a modern permanent road on a location made years ago under entirely different conditions. Railroad engineers have shown the wisdom and economy of expending large sums of money in order to obtain better locations. With the advent of the large, heavily loaded motor truck, the principles controlling highway and railroad location have become more closely associated, and the principles governing railroad location should be more closely followed.

HORATIO L. BAKER,
First Lieutenant, D Company, Twenty-third Engineers.
U. S. A., P. O. 903, American Expeditionary Forces.

Correction of Level Notes for Personal Equation and Other Errors

Sir—The writer had occasion last summer to work out a method of eliminating errors and personal equations in leveling which, to the best of his belief, is new and most promising. It is as follows:

In adding to the distribution system served by the Elephant Butte dam below El Paso, Tex., under the United States Reclamation Service, topography was to be taken over a strip of valley some 45 miles long. A transit control line was run, and at every sixth station a special hub was set for a benchmark. Levels were then run on these hubs, with readings to thousandths, by three level parties, working one after the other but absolutely independently. Set-ups were made at the station stake midway between the hubs, thus eliminating instrumental errors as much as possible. The three chiefs of party were not allowed to compare notes on elevations.

When the results came in, the values of the final point all checked within a foot, and considerable discussion ensued as to the proper method of evaluating them. The first levelman was a very experienced man, while the second and third were much younger, one being still graded as a rodman. The tendency of the office force was to discard the results of the two less experienced men, but the writer argued against this and won.

In order to present the matter graphically, as the chief had to be "shown" and his time was limited, the writer devised this scheme: Upon a sheet of profile paper were plotted the differences between each pair of notes for each hub. Thus, if the three sets of levels are designated A, B and C, at each point A-B, B-C and A-C were plotted, and all A-B values joined, etc. If for a given point A gave 3597.077, B gave 3597.032 and C 3597.859, A-B was plotted at plus 0.045, A-C at minus 0.782 and B-C at minus 0.827, care being taken to observe algebraic signs. These points were then joined with the corresponding points for the preceding hub, which were plotted on the preceding vertical subdivision. The result was three surprisingly regular curves, often crossing and recrossing the zero line, and with a few noticeable irregularities. These breaks, of course, were the significant features and were investigated carefully. Where all lines were running comparatively parallel and two lines dropped or rose over a certain hub and returned to the former relative positions at the next hub, it indicated a disturbed point, or dirt on the hub. However, if the two lines, after jumping, failed to return but continued parallel to the previous course an error in rod reading was thereby indicated in the set of notes common to the two lines, and the amount was evident.

Thus, if B-C and A-C lines jumped two hundredths at one hub and continued parallel afterward, it showed that C was out two hundredths from that point on. The scale was made such that thousandths were easily read. Numerous errors were detected in this way, and the notes of each party were corrected accordingly and the differential values once more plotted. This last plat showed one set of levels to be less reliable, as two of the lines were quite irregular, while the third ran smoothly throughout. The two sets of notes represented by the third line were then averaged, and the values obtained tabulated for permanent use.

A curious feature aroused some discussion regarding the third, or smoothest, curve. The digressions from the zero line were regular, nearly equal, and recurred at strikingly regular intervals, almost following a sine curve. The most plausible theory advanced to explain this was that the parties did not work at the same speed, one being noticeably slower. Therefore, one stretch would be traversed by both at the same time of day on different days, and other stretches would be covered by one party in the morning of a certain day and by the other in the afternoon. Since the daily range of temperature was high at that time, it is thought that the increased mutual discrepancies occurred at points where readings were made at opposite hours of the day, and were due to expansion and contraction of the earth's crust during the day.

It also appeared that the more experienced levelman had fully his share of errors in rod readings, while the "greenest" man had the least, showing that results should not be entirely discarded, no matter what the ability of the observer. Also, the use of the third set enabled the writer to place each error positively and correct it without another trip in the field.

All persons who inspected the curves and the results agreed that the method was novel and extremely useful, as the "why and wherefore" of all corrections was seen at a glance. I trust others may find its use convenient.

The work in question was done in connection with the Fort Hancock survey, in August, 1918, under Assistant Engineer J. G. Marzel, of the Clint, Tex., office, where the writer was chief of party acting as office engineer.

RUSSELL A. TRUFANT,
American Rio Grande Land & Irrigation Company.
Mercedes, Tex.

HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Side Chute Charges Wheelbarrows From Cement Wagon

BULK cement hauled in wagons and unloaded by detachable measuring chutes from the wagons to the charging barrows was used in paving 7000 ft. of Main St., North Chicago, Ill. Ten carloads, or 3000 bbl., of cement were handled, and the contractors, the James Cape & Sons Co., Racine, Wis., state that they intend to use bulk cement on all future contracts where the consumption exceeds 150 bbl. per day. The haul from the railway to the work was about one mile. Three wagons, which were equipped with 20-bbl. metal-lined grain boxes, were routed so that one wagon was at the car taking its load, one was en route between the car and the work and the third was at the work discharging its load. One team did the hauling. An average of eight wagon loads per nine-hour day was hauled.

Other Articles in This Issue of Interest to Contractors:

Governors' and Mayors' Reconstruction Conference Fails to Get Action — Page 511

Pennsylvania Has Emergency Public Works Commission — Page 516

Old-Fashioned Methods Reduce Cost of Dam Repairs — Page 517

Day Labor Does Municipal Work at Flint, Michigan — Page 524

Concrete Is Handled in Several Ways on Bridge Abutment Job — Page 533

At the car, the cement near the door was shoveled directly into the wagon. When enough cement had been removed to make the distance too great for shoveling, wheelbarrows were used. A steel plate bridge from car to wagon permitted the barrows to be dumped directly into the wagon. One man did the unloading. At the work, the chute was hooked into the wagon body and one man did the unloading. The chute was a broad box 24 in. high and 12 in. square, with a hopper 18 in. high and 24 in. square at the top. A slide gate at the bottom of the chute and another at the bottom of the hopper made the chute a measuring box of 2-cu.ft. capacity. The hopper, level full, also held 2 cu.ft. By alternately opening and closing the slide gates, wheelbarrows were charged with 2-cu.ft. batches of cement, and were then wheeled to the mixer and dumped directly into the charging skip. One or two men did the wheeling.

Canvas covers for the wagons prevented any loss of cement from rain.

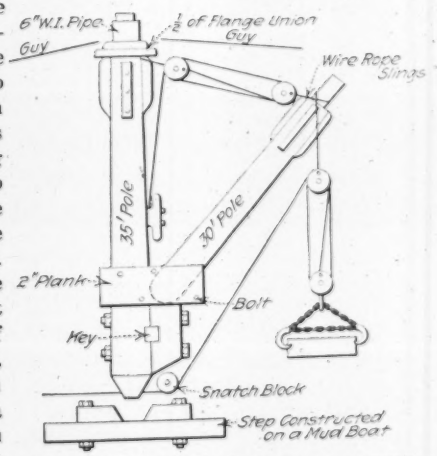
MEASURING CHUTE ON WAGON CHARGES BULK CEMENT INTO BARROWS

Improvised Derrick Without Usual Irons

BY SAMUEL P. BAIRD

Columbus, Ohio

THE accompanying figure illustrates an improvised boom derrick, built without the derrick irons which would ordinarily be thought necessary. The principal features are the step-bearing for the mast, the step for the boom and the means for allowing the mast to rotate at the top. The rope used was 1-in. manila, the boom hoist was a pair of double blocks, and the main hoist was a combination of a double and a triple

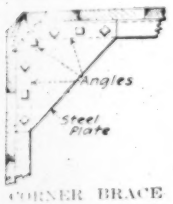


NO DERRICK IRONS USED IN THIS HASTILY IMPROVISED RIGGING

blocks. The main power was a steadily moving team. The loads lifted were stone weighing about a ton, and they were raised high enough for a truck to back under. A friction drag was provided on the main fall line, to lower the load and to allow the team to return as soon as the load was raised to the desired height.

Rigid Corner Frame Permits Frequent Re-use of Concrete Forms

REMOVABLE corners for concrete forms, such as the one described in *Engineering News-Record* of Jan. 23, 1919, p. 203, have been used for some time by E. H. Oneal, of Globe, Ariz. A special type for shaft concreting is shown in the accompanying sketch. It consists of a drilled and shaped steel corner plate to which are bolted angles carrying the side planks of the form and a special corner piece. While the cost of the individual forms was high, the cost per unit of conrete was low because the forms could be used over so many times. Some were re-used 26 times and were still in good condition. To strip such a form, the bolts are unscrewed and the separate plank sections lifted out.



CORNER BRACE FOR CONCRETE FORM

Economical Nonfreezing Type of Outlet Valve

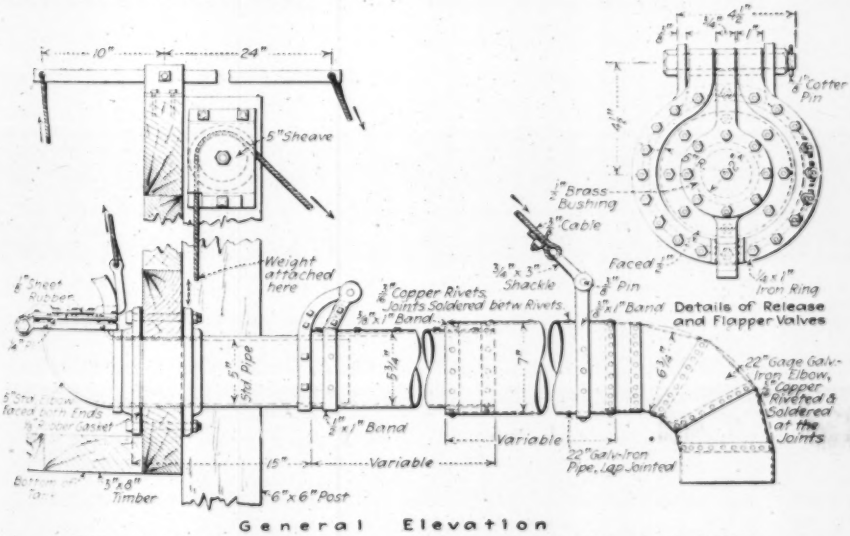
By John H. Sawkins
Instructor in Drawing, Civil Engineering Department, Union College, Schenectady, N. Y.

AN OUTLET valve suitable for temporary watering tanks, such as are used by contractors for watering dinkies on filling and excavation contracts, is shown herewith. The advantages of this type are: (1) It can be made at small cost, using standard pipe fittings and other material commonly found in any small machine shop; (2) it is simple both in construction and operation; (3) it is especially adapted to winter work, being practically nonfreezing.

As indicated in the drawing, the valve consists essentially of a standard cast-iron elbow, two cast-iron pipe flanges and a short length of common pipe. The detail drawing of the combined release and flapper valves shows clearly that all the component parts are simple pieces easily made, standard bolts being used for connecting the pieces. It is recommended that a good grade of sheet rubber be used for facing the plates, and that the elbow be faced very carefully on a ring $\frac{1}{2}$ in. wide, in order to secure a water-tight connection between it and the rubber, thus avoiding undue leakage of water, which may cause the valve to freeze. The same applies to the connection between the rubber and the brass brushing.

The operating device is especially made to withstand rough usage usually given by firemen who operate such valves, simplicity in both design and operation being the feature sought. The valve is particularly designed to adapt it to winter conditions, since much trouble has been caused to contractors in obtaining an outlet valve servicable under all weather conditions.

The location of the valve as shown in the general assembly view offers least chance for trouble due to freezing if the tank is at all times kept nearly full of water.



General Elevation

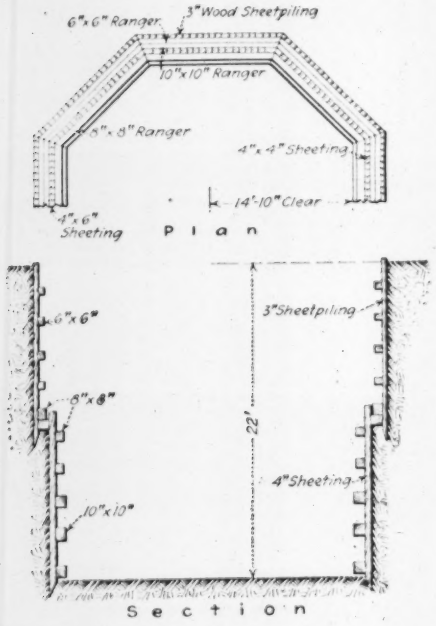
DETAILS OF NONFREEZING OUTLET VALVE FOR WATERING TANK

Bracing Eliminated in Sheeting Octagonal Excavation

By W. K. Knauff
Supervising Construction Engineer, Delaware City, Del.

IN ORDER to keep the excavation for a sewage pumping station at Fort du Pont, Delaware, unencumbered with braces during concreting, the layout of the sheeting as a regular octagon with mitred rangers was designed. Rangers of various sizes formed a complete octagonal ring, the rangers butting into each other at the corners with a miter cut. Vertical blocks, two to each side, supported each set of rangers from the one below, and no other bracing was employed.

The first set of sheeting was made up of 3 x 6-in. rough boards 14 ft. long, spiked together three to a pile, and arranged to give a 2-in. tongue-and-groove. A plank templet was made with inside dimensions equal to the outside dimensions of the excavation, and eight special corner piles were made up and started, one at each corner of the octagon. The flat sheeting was then placed to complete the sides. As the excavation progressed, 6 x 6-in. oak rangers were placed about 2 ft. 6 in. on center, the joint between the first and eighth sides being made by raising these pieces sufficiently to bring the lower edges of the miter together, and then forcing them back to the horizontal by jack screws. In this way each set was brought to a



EXCAVATION KEPT CLEAR BY OCTAGONAL LAYOUT

firm bearing against the sheeting itself. At about 8 ft. the sheeting could not be driven more than a foot below the lowest set of rangers without curling badly and having to be cut off on account of lack of stiffness. The trouble was overcome by making a ring of 8 x 8-in. timbers and jacking it down as the excavation progressed. The upper set of sheeting was carried to a depth of 12 ft., a set of 10 x 10-in. rangers being placed near the bottom and used as a templet by the lower set of sheeting.

The lower sheeting was composed of 4 x 6-in. yellow pine, 12 ft. long, tongued and grooved and center matched, the eight corner pieces being made up and spiked together as before. The rangers were made in complete rings, two sets of 8 x 8-in. timbers and two sets of 10 x 10-in. One set of 10 x 10-in. timbers was jacked down as the excavation progressed, to keep the sides from curling in, because even the 4 x 6-in. sheeting was not stiff enough to resist the side pressure. This set of sheeting was carried down to the bottom of the excavation about 22 ft. below the surface of the ground.

The site of the excavation was in low-lying ground near a marsh, and the excavated material was fine mica sand, water having been encountered about a foot below the surface. Although at times the pumping capacity of the plant was taxed to keep the water low enough for the men to work, comparatively little difficulty was experienced in the wash around the timbering. The excavated material was handled by a small derrick operated by a 12-hp. gasoline hoist. The sheet piling was driven by a 4-in. McKiernan-Terry sheeting hammer. The scheme was devised to enable the work to be carried on with as little delay as possible, utilizing the equipment and material available locally, sheet-steel piling and an orange-peel excavator not being procurable except at the cost of considerable delay.

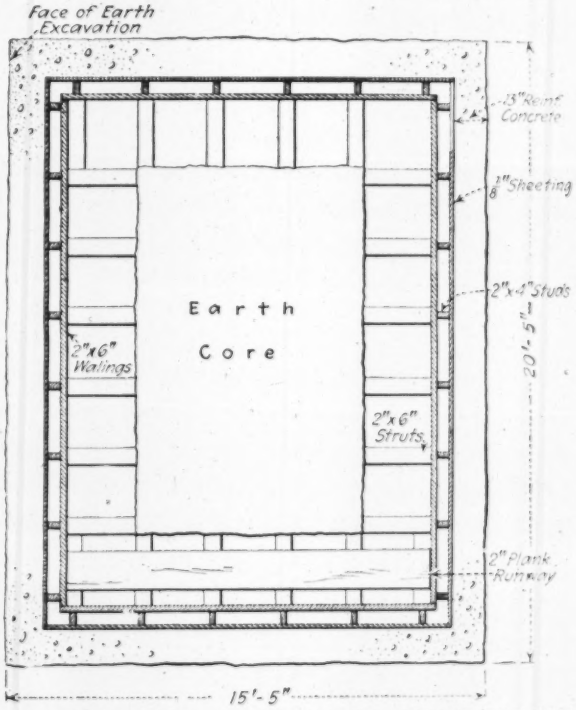
The work was performed by R. G. Collins, Jr., general contractor, under the direction of Capt. J. A. Sears, constructing quartermaster, U. S. A., with the writer as supervising construction engineer.

Concrete Walls Poured Before Core is Excavated

By D. H. Fleming

Assistant to City Engineer, St. Catharines, Ontario, Can.

A RECENT Canadian contract called for the excavation of a pit 15 x 20 ft. in section and 30 ft. deep, and the construction of reinforced-concrete walls, etc. The material encountered was a hard, tough clay and the contractor excavated a trench about 4 ft. wide around the outside, in much the same manner as for a sewer trench. The reinforcement was then tied in place and inside forms were erected in 4-ft. lifts, constituting a day's work. After the concrete walls were poured and the forms taken out, the earth core was excavated. This



30-FOOT PUMP WALL SHOWING CORE SUPPORTING FORMS

method enabled the contractor to save the expense of large timbering, which would have been required for struts or props. It aided in the protection of the concrete from freezing and enabled the contractor to pour the concrete during a spell of good weather, leaving the excavation work to be done later.

Seattle Plans for Reconstruction

Reconstruction questions of the City of Seattle, Wash., and King County are to be considered by a large commission which has been appointed by Mayor Hansen and which will coöperate with similar commissions throughout the state. In addition, the authorities are planning to commence work on a water-supply extension to cost nearly $4,000,000, a hydro-electric plant to cost $5,500,000, and street and sewer work totaling about $3,000,000.

NEWS OF THE WEEK

New York, March 13, 1919

Price Stabilization Board Appointed

Action on Secretary Redfield's plan for a stabilization of prices by co-operation between the producer and the Government has been started by the appointment of the members of the Industrial Board of the Department of Commerce, which, with the Council of National Defense, will act for the Government. The chairman of the board is George N. Peek, of Moline, Ill., formerly with the War Industries Board and vice-president of Deere & Co. The other members are Samuel P. Bush, Columbus, Ohio, president of the Buckeye Steel Castings Co.; Anthony Caminetti, Washington, D. C., commissioner general of immigration, Department of Labor; Thomas K. Glenn, Atlanta, Ga., president of the Atlantic Steel Co.; George R. James, Memphis, Tenn., president of the William R. Moore Dry Goods Co.; T. C. Powell, Cincinnati, Ohio, director of the Capital Expenditures Committee, United States Railroad Administration.

The board expects to begin immediately conferences with representatives of various basic industries, in the hope of establishing the lowest possible prices which can be offered at present. Government buying will then be made on the basis of such prices, which will not be fixed, as during the war, but will be given wide publicity for the information of the private buyer. The producer, of course, will not be forced to accept any such established price, but it is hoped that the weight of the Government statement of a fair price will serve to establish such a standard.

American Mayors' League Proposed

Immediately after the recent Governors' and mayors' conference in Washington, a number of the mayors present met and unanimously voted to recommend to all mayors of cities of 25,000 population or over the formation of a permanent organization which may perhaps become known as the American Mayors' League. A resolution was passed requesting the Secretary of Labor to call such a conference not later than Feb. 1, 1920. The opinion of all present was that there should not be over one set speech each day of a conference extending to at least four days. It was also voted that Congress be asked to adjourn at least one day during the conference, and hear the report which the mayors might have to offer. The following committee was appointed to take all matters concerned into consideration and report: Chairman, George L. Baker, mayor of Portland, Ore.; secretary, R. W. Babson, Boston; together with F. W. Donnelly, Trenton, N. J., W. Montague Ferry, Salt Lake City, Daniel W. Hoan, Milwaukee, Wis., and R. J. Wheeler, Allentown, Penn.

Employment

For the convenience of engineers returning from military life, and others, there are listed below agencies which may be helpful to those who are seeking employment:

Professional and Special Section, United States Employment Service; Thomas T. Read, manager Eastern zone, 16 East 42nd St., New York, and Ward R. Robinson, manager, Central and Western Zone, 63 E. Adams St., Chicago.

1518 Walnut St., Philadelphia.

16 Tremont St., Boston.

Engineering Societies Employment Bureau; Walter V. Brown, secretary, 29 West 39th St., New York City.

American Association of Engineers, F. H. Myers, manager, 29 So. La Salle St., Chicago. Service to members only, but Army or Navy engineers in uniform who are eligible to certified membership may join without payment of entrance fees or dues while in uniform and for six months after discharge.

Penalty for Municipal Strikers

Loss of annual vacation has been imposed as penalty on city employees of Seattle who joined the recent general strike in that city. In addition, 15 days' pay will be withheld from those who did not respond to Mayor Hanson's demand that they return to work. A request of the Central Labor Union to rescind this ruling has been denied

Commissioner of Public Works for Oregon

In connection with a proposed $3,000,000 reconstruction bond issue to be used for public buildings and a $1,235,000 appropriation for new buildings, alterations and repairs authorized by the recent session of the Oregon legislature, provision has been made for the office of commissioner of public works. The commissioner will be under the direct supervision of the State Board of Control, which has charge of state construction work.

Proposes Rapid Transit Viaduct Across New York Bay

Rapid-transit connection of Staten Island with the main business district of New York City, brought to the fore recently by suggestions to begin the construction of the long-contemplated extension of the Brooklyn Fourth Ave. subway to Staten Island by a tunnel under the Narrows, is the subject of a remarkable alternative project submitted to the Staten Island Subway Committee recently by S. Johannesson, a New York engineer.

This project contemplates a viaduct railway crossing New York Bay from Ellis Island to Staten Island, a distance of about 22,000 ft., supplemented by a tunnel about 7500 ft. long from the Battery, Manhattan, to Ellis Island. The entire line is estimated to cost about $18,000,000.

Course of Proposed Structure

Passenger and wagon connection between Manhattan and Staten Island is made at present by a line of ferry boats running from South Ferry, Manhattan, to St. George, Staten Island, a distance of five miles. The proposed structure would parallel the course of these boats a short distance to the west, being laid close along the established pierhead line on the New Jersey shore, off Bayonne, for the entire distance south of Ellis Island. It is intended to adapt the structure to the necessary future development of this riparian district for steamship service, by placing the supports of the viaduct so that they would come within the pier areas, the spans crossing the slips between piers and giving unencumbered passage to vessels. For the present design a slip width of 300 ft. and a pier width of 150 ft. have been used, and the structure as designed consists of a series of steel arch spans across the slips, shaped so as to give a full 00-ft. clearance height for the entire width of the slip, and connected by girder spans over the piers, these spans preferably to be masked by stone or concrete face walls. At the south end of the line, where the route crosses the Kill von Kull, the entrance to Newark Bay and Staten Island Sound, a clearance height of at least 140 ft. will be required, and here two 500-ft. spans across the channel are provided. The water and ground conditions over the entire length of the viaduct are favorable, it is asserted, the water depth varying from 5 to 20 ft., and rock being found at relatively shallow depth. The tunnel under the Hudson River from the Battery to Ellis Island would have

to deal with a maximum channel depth of something over 50 ft. At its southerly end it would rise on a 3% grade to the Ellis Island portal.

Great saving of transportation time as compared with the route through Brooklyn is claimed for this project. Furthermore, as the Fourth Ave. subway is largely taken up with Brooklyn traffic, only a small margin of capacity is available for through traffic to Staten Island, whereas it is asserted that the bridge route would provide all needed capacity. The structure as designed, and the estimate above quoted, contemplates a two-track railway and a two-line vehicle roadway.

Why More Catskill Water is Needed by New York City

Rainfall of but 43 in., compared with 47 in. as the average on the Catskill drainage area for the past 13 years, and a large use of Catskill aqueduct water to save pumping for Brooklyn Borough, had drawn down Ashokan reservoir storage to 56,000,000,000 gal. and Kensico reservoir storage to 17,000,000,000 gal. Mar. 1, according to information from the engineering department of the Board of Water Supply, New York City.

The maximum capacity of these reservoirs is 128,000,000,000 and 29,000,000,000 gal., respectively. The safe daily capacity of the area tributary to the Ashokan reservoir is 250,000,000 gal., but for more than a year the reservoir has been delivering 380,000,000 gal. a day and the city has been using 430,000,000 gal. daily from the Catskill supply. The excess of use over Ashokan reservoir delivery has been made up of 50,000,000 gal. a day drawn from storage in the Kensico reservoir and 20,000,000 gal. from area tributary to Kensico. Indications are that pumping may again be necessary to supply Brooklyn. There is no danger of a water shortage, it is said, as the Croton reservoirs are about full, but Catskill water can be delivered so as to avoid pumping. Already some $2,000,000 of pumping costs have been saved by the Catskill gravity supply.

The Board of Water Supply is now building the Shandaken tunnel, which will divert water from the Schoharie drainage area to the Ashokan reservoir and make possible a delivery of 500,000,000 gal. a day through the Catskill aqueduct. The tunnel is 18 miles long and will not be completed for some five years. Plans are being made for a dam at Gilboa to store Schoharie water, and it is hoped that its construction can soon be undertaken, both as an essential part of the Catskill supply and to help furnish employment. The cost of pumping the 250,000,000 gal. a day which the Schoharie will yield would be about $2,000,000 a year. The entire estimated cost of the Schoharie project is $22,175,000. J. Waldo Smith is chief engineer and Thaddeus Merriman is deputy chief engineer of the Board of Water Supply.

Hurley Reports on Cancellations of Ship Orders

In a statement to the chairman of the House Appropriations Committee, E. N. Hurley, chairman of the Shipping Board, has given the first definite facts on the cancellations of ship orders by the Emergency Fleet Corporation. In this statement he says that up to Jan. 1, 1919, contracts for 107 ships (55 steel, 32 wood, and 20 concrete) had been suspended or canceled. Up to Feb. 15, 1919, the cancellations and suspensions had increased to 550 vessels, most of them steel. The total represents about 2,700,000 dead-weight tons carrying capacity, and over $400,000,000 in cost.

Present construction by the Emergency Fleet Corporation totals roughly 10,000,000 dead-weight tons. This, with foreign construction, is expected to produce by 1921 a world's fleet about 5,000,000 tons ahead of that of 1914. With respect to further cancellations, Mr. Hurley stated: "We are already presented with heavy claims for damages as the result of the cancellations we have already made. To make many more would . . . . disturb the labor conditions of the country . . . . cause failures in the shipbuilding trade . . . . destroy the fortunes of people who have invested in these industries." And he advised against attempting to cancel more contracts.

Report on Federal-Aid Highways Misleading

Federal-aid highways to the amount of 793 miles, instead of 45 miles as indicated by a recent report of the Department of Labor, have been constructed, according to a statement of P. St. J. Wilson, acting director of the Bureau of Public Roads. The Department of Labor apparently only considered completed and accepted projects instead of completed miles of highway. Inasmuch as over $2,000,000 had been paid to the states, and as the reported condition was being used as an argument against further appropriations for this purpose by Congress, Mr. Wilson prepared for publication a report of which a part follows:

"Of the appropriations made by the Federal-aid road act, as approved July 11, 1916, $30,000,000 is now available and $20,000,000 additional will become available July 1, 1919, which amounts, less the 3% deducted for administration, have been apportioned among the states. To Jan. 31, 1919, projects had been approved involving a total of 8903 miles of road and $23,526,102 of Federal aid. Of this mileage, notwithstanding war conditions and the restrictions necessarily resulting therefrom, the equivalent of 793 miles had been completed on the above date, requiring an expenditure of about $2,096,000 of Federal funds. Of the mileage represented in approved projects, there remain yet to be constructed about 8110 miles, which will involve about $21,430,102 of Federal funds. The indications are that an immense of construction work, both delay new projects, will be undertak ing the 1919 construction seaso

Reports received by the bur dicate that $385,000,000 will b for roads and bridges during th ing season in the United State the new Federal-aid appropriati proved by Congress, if utilized states, will add several million d to this sum.

Oregon Reconstruction Bond I

The legislature of Oregon has pa a bill providing for a $3,000,000 r struction bond issue, subject to popular approval at an election to be held June 3. The money will be used for various public buildings, including $500,000 for a new penitentiary, $350,000 for a reconstruction hospital with a possible expenditure of $500,000 under certain contingencies, and $500,000 for buildings at Corvallis for the Oregon Agricultural College, and another $500,000 for buildings at Eugene for the University of Oregon, the college work to be carried out jointly by the regents of the two institutions.

Improve Kansas City Water-Works

Improvements to the water-works of Kansas City, Mo., interrupted by the war, will be put under way at once, according to information from W. G. Goodwin, chief engineer and superintendent. The city expects to advertise within two or three weeks for bids for a 16,000,000-gal., reinforced-concrete reservoir. A contract for the excavation for this work has already been let. Plans are being prepared for a new high-service pumping station. Bids will soon be advertised for a 50,000,000-gal. low-service pump. A 20,000,000-gal. high-service steam turbine pump for the new station has already been contracted for. Possibly the low-service station will be moved to the Missouri side of the river. It is hoped that filtration will be taken up in the near future. Water-works improvement bonds to the amount of $1,500,000 were authorized about a year ago.

Professional Employment Service Opens New Offices

In order better to place the many returning Army officers in suitable business positions, the United States Employment Service has opened two zone offices in addition to the main ones in New York and Chicago. Besides the two just ready for business at 1518 Walnut St., Philadelphia, and 16 Tremont St., Boston, other offices will be opened soon, each to serve the particular zone in which it is located.

Applicants are required to make out detailed statements of experience and are personally interviewed, in order to determine just what work they are best fitted for. Likewise, employers are requested to be as specific as possible regarding their requirements.

[illegible] soldier—officer or private—on leaving the Army is reminded that the Employment Service stands ready to help him hunt a job, and a surprisingly large number are taking advantage of the offer. Employers who desire to build up their organizations with discharged officers are requested by the Employment Service to get in touch with the nearest Professional and Special Section office.

Propose Conference on Column Formula and Train Loading

Appointment of a conference committee of the American Society of Civil Engineers, to obtain joint action on a column formula and a standard train loading for use in bridge design, was proposed at the meeting of the society Mar. 5. The American Railway Engineering Association has under consideration revised specifications for railway bridges, which contain a column formula of the parabolic type, a form hitherto not used in bridge or structural practice in this country. In view of this, C. E. Fowler moved that the Board of Direction of the society appoint a committee to confer with the association "in regard to delaying the adoption of the proposed column formula, which is somewhat revolutionary in character." The same committee is to attempt to secure agreement on a new train loading for bridge design, in place of the Cooper loading now widely used and adopted also in the new specifications. J. E. Greiner seconded the motion, which was passed by the meeting.

New State Highway Commissioner Nominated in New York

Governor Smith of New York has sent to the Senate the nomination of Col. Frederick Stuart Greene of Sands Point as state Commissioner of Highways to succeed Edwin Duffey, who was appointed during Governor Whitman's administration.

Goethals Retires to Civil Life

Maj. Gen. George W. Goethals, director of purchase, storage and traffic, General Staff, U. S. A., has retired to civil life. In a letter to General Goethals, made public by the War Department, Secretary Baker says:

"The success of your work is manifest, and I have no doubt when the history of this great undertaking comes to be written, your contribution to the success of the country in the war will be an outstanding feature."

Will Be Renamed Newlands Project

The Truckee-Carson irrigation project in Nevada, it is announced by Secretary Lane, will be known hereafter as the Newlands project, in commemoration of the late Senator Francis G. Newlands, who was the father of the reclamation law.

Notes from the Field

Confidence is one of the necessary ingredients for sustained relations between buyer and seller. So, too, is it a condition for lasting industrial peace. That such peace is not impossible of attainment is shown by the following story, told by an engineer who adjusted labor controversies during the war. When trouble impended he put the determination of the proper wage up to a single individual—sometimes a manager, sometimes an employee. Invariably both sides were satisfied with the award.

The selection of the man in whom implicit confidence could be placed was made in a variety of ways. Sometimes a labor leader would suggest the right man, at other times a banker, another employer, or some citizen whom the adjuster could trust. It so happened that a manager was selected quite as often as a worker. The critical point was to get a man who knew the situation and could be trusted. The procedure was something like this:

The individual chosen would be invited to the adjuster's hotel. "I'm told," the adjuster would begin, "that you are perfectly square and that I can rely on you to deal honestly with me and with the Government. Forget now that you are an employer [if such were the case] and consider yourself just a patriotic American, trying to help win the war. The employees demand 75c. an hour. You and your fellow employers are standing for 60c. I want you to write down the proper scale. Whatever you write, I'll approve. In other words, you, acting for the Government, must determine the award in this dispute. You know the whole situation. I do not. I'm acting in this way because So-and-so has told me that you are square, that you will not "double-cross" me and the Government.

Invariably there was a refusal, the individual protesting that he could not depart from the figure his confreres were fighting for. In the end, though, the adjuster's appeal would win, and only in one instance did the selected individual, by setting the wrong figure, betray the confidence that had been reposed in him.

But the important part of the story is this—that if the new scale had been set by a labor representative, the employers invariably wanted to know by what process the adjuster had been able to hit on just the right figure, while if a manager had set the wage for settlement, labor was mystified as to the process by which the right figure had been reached. In other words, both sides knew what was right. Traditional antagonism and hope that by strike one of them might gain an advantage or additional concessions kept them apart.

Had there been confidence that both parties would be fair, the mediation of the adjuster would not have been needed.

The great industrial problem is to establish this confidence. E. J. M.

West Virginia Legislature Votes Large Highway Bond Issue

After a vigorous campaign, the West Virginia legislature has adopted unanimously an amendment to the constitution, providing for a definite system of state roads and for the issuance of $50,000,000 of state bonds, outstanding at any one time, for highway construction and maintenance. At the same time the legislature passed unanimously a provision reëstablishing the road school at the state university. The system as proposed will connect the various county seats.

Form American Welding Society

The formation of the American Welding Society is announced in a recent statement from H. C. Forbes, secretary of the temporary organization, at 29 W. 39th St., New York City.

This society will be a merger of the Welding Committee of the Emergency Fleet Corporation, and the National Welding Council, and will include others who may be interested.

It is the purpose of the society to become a disinterested and dependable source of information on welding, not only for the benefit of the manufacturers of welding apparatus and supplies, but also to aid those who use welding in their production and those who purchase goods into which the welding process enters.

The first meeting will be held Mar. 28, 1919, at the Engineering Societies' Building, 29 W. 39th St., New York, at 10:30 a. m.

Civil Service Examinations

For United States Civil Service examinations listed below, apply to United States Civil Service Commission, Washington, D. C., or to any local office of commission, for form 1312.

United States.—Superintendents of road construction, Bureau of Public Roads, Department of Agriculture, Mar. 25: Class A (candidates with four years' responsible charge of construction) $150 to $175 per month; Class B (six years' responsible charge) $185 t o$225; Class C (eight years' responsible charge) $230 to $250 a month. File applications before Mar. 25.

United States.—Assistant examiner, Patent Office, Washington, Mar. 26-28, and May 21-23 and July 23-25. Pay, $1500 per year. File applications in time to arrange for examination at place selected by applicant.

United States.—Chief physicist, qualified in aëronautics, National Advisory Committee for Aëronautics, Langley Field, Hampton, Va., Mar. 25, $3000 per year. Also physicist, $2100 per year. File applications before Mar. 25.

United States.—Senior highway bridge engineers, Apr. 1, Bureau of Public Roads, Department of Agricul-

ture, Washington, D. C. Grade 1 (examination percentage above 70) $2400 to $2700 per year; Grade 2 (percentage above 80) $2800 to $3000 per year; Grade 3 (percentage above 90) $3100 to $3400 per year. File application before Apr. 1.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

AMERICAN RAILWAY ENGINEERING ASSOCIATION; 910 Michigan Ave., Chicago; Mar. 18-20; Chicago.

NATIONAL FIRE PROTECTION ASSOCIATION; 87 Milk St., Boston, Mass.; May 6-8, Ottawa, Can.

AMERICAN ASSOCIATION OF ENGINEERS, 29 S. LaSalle St., Chicago; May 13-14, Chicago.

The National Highway Traffic Association will hold a public meeting at the headquarters of the Automobile Club of America, New York City, Mar. 21. The Hon. Francis M. Hugo, secretary of state, New York, will speak on "Qualifications for Operators of Motor Vehicles and Revocation of Licenses," and Shirley W. Wynne, Department of Health, New York City, on "Regulation of Pedestrian Traffic." Elmer Thompson, secretary of the Automobile Club of America, will read a paper on "Signposting for Detours and Through Routes in Municipalities." A committee report will be presented on "General Highway Traffic Regulations for Drivers, with Directions for Pedestrians."

The New York Chapter of the American Association of Engineers will hold a meeting at the Hotel McAlpin Mar. 28. C. E. Drayer, national secretary, will speak on "The Aims and Accomplishments of the American Association of Engineers." All engineers, whether members or not, are invited to attend and participate in the discussion. Mr. Drayer will spend two weeks in the East, studying the field in order to find how the association can best serve the profession in that part of the country.

The Engineers' Club of Columbus, Ohio, has made arrangements for permanent quarters in the Southern Hotel. Dudley T. Fisher addressed the club Feb. 28 on "Why Does the Inventor Fail to Receive the Expected Reward?" The legislation committee reported that Senate Bill No. 2 permitting chemical closets in school buildings had passed the Senate in spite of efforts against it by the club's committee and by the State Board of Health.

The Detroit Engineering Society held a meeting Mar. 7 at which David A. Molitor delivered an address on "The International Metric System of Weights and Measures." The society will hold a joint meeting with the Detroit Section of the Society of Automotive Engineers Mar. 21. Elmer A. Sperry will speak on "The Gyroscope in Modern Warfare."

The Colorado Association of Members of the American Society of Civil Engineers held a regular meeting Mar. 8, which was addressed by F. A. Banks, engineer, United States Reclamation Service, who spoke on "The Jackson Lake Dam, Wyoming." Mr. Banks' paper dealt with a description of development of storage and construction features and methods of delivering the stored water in the Snake River Valley, Idaho.

The Brooklyn Engineers' Club will be addressed Mar. 13 by James A. Donnelly on "Air Return Systems of Steam Circulation." Mr. Donnelly's paper will deal with steam and return mains and air-valve systems. On Mar. 20 Charles Evan Fowler will address the club on "Bridge Architecture and Construction," illustrated with lantern slides.

The Engineers' Club of Philadelphia was addressed Mar. 7 by Col. Edwin A. Havers, who spoke on "The Evolution of the Pen." I. W. Litchfield, director, technical division, United States Employment Service, will speak on "The Work of the Professional Section of the United States Employment Bureau," at the weekly luncheon Mar. 18.

The Michigan Engineering Society Feb. 28 appointed a special committee to consider the proposal for reorganization for the purpose of broadening the influence of the society by affiliating with it all the local engineering societies in the state, as mentioned in *Engineering News-Record* of Feb. 27, p. 448.

The Philadelphia Chapter of the American Association of Engineers recently elected the following officers: F. P. Roth, president; L. F. Boon, vice-president; M. F. Frick, recording secretary; H. F. Kuzel, David Lupton Son's Co., corresponding secretary.

The Montreal Branch of the Engineering Institute of Canada will be addressed Mar. 20 by W. H. C. Mussen on "Ball-Bearing Jacks" and by Ernest V. Moore on the subject of "Peat."

The Louisiana Engineering Society held a meeting Mar. 10 at which W. T. Hogg read a paper on "Suggested Changes in the Operation of the Street Railway System of New Orleans."

The Engineers' Club of Trenton will be addressed by William G. Thompson, state engineer of New Jersey, on "A National Highway Policy and Plan," at the meeting Mar. 13.

PERSONAL NOTES

MAJ. MARSHALL R. PUGH, Engineers, U. S. A., previously post engineer, Bordeaux Embarkation Camp, is now engaged in the cancellation of contracts for the United States Shipping Board, Emergency Fleet Corporation, having been discharged from Army service. Before the war he was in private practice as a member of the firm of Pugh & Hubbard, civil and sanitary engineers, of Philadelphia.

DR. HARLOW S. PERSON, director of the Amos Tuck School of Administration and Finance, Dartmouth College, and professor of organization and management, has resigned to become managing director of the Taylor Society, which will open permanent offices in the Engineering Societies' Building, 29 W. 39th St., New York City, Apr. 1. For several years Dr. Person has acted as president of the society, to which he will now devote his entire time.

MAJ. BRINTON BUCKWALTER, Ordnance Department, U. S. A., has been appointed manager of the New York branch, at 25 Pine St., of the Thompson & Lichtner Co., industrial and management engineers of Boston.

MAJ. WILLIS B. HAYES, Engineers, U. S. A., has been detached from the 210th Regiment at Camp A. A. Humphreys, Virginia, and has been appointed chief educational officer for occupational training at Base Hospital No. 31, Carlisle, Penn.

LIEUT. C. W. MARSHALL, Construction Division of the Air Service, U. S. A., previously assistant engineer, Bates & Rogers Construction Co. at Cleveland, has received his discharge and become sales engineer, Concrete Steel Co., western division, with office in Chicago. Lieutenant Marshall entered the service in 1917 and afterwards became assistant superintendent of construction at Ebberts Field, Arkansas, and Payne Field, Mississippi. He was later superintendent of construction at the flying field at Babylon, Long Island.

R. H. ROWLAND, previously associated with T. E. Murray, consulting engineer, New York, has engaged in private practice with office at 50 Broad St., New York City, as a designing and consulting engineer, specializing in mining, sugar and industrial plants.

J. C. MCVEA, office engineer, engineering department, City of Houston, Tex., has been appointed city engineer, succeeding E. E. Sands, who resigned

to engage in private practice, as noted elsewhere. Mr. McVea, who is president of the Houston Engineers' Club, is a graduate of the University of Texas and had been in the engineering department of the Southern Pacific Co. for about 10 years.

ARTHUR S. HOBBY, previously associated with the Snare & Triest Co. at Havana, Cuba, has become assistant to the president, North Coast Rys. of Cuba, with headquarters at Moron, where he will have charge of construction work.

LIEUT. WALTER S. ANDERSON, of the Aviation Corps, formerly in the Chicago office of the Universal Portland Cement Co., attached to the inspection department, has been discharged from the Army and has entered the paving-plant department of the Lakewood Engineering Co., as field engineer, located in the Chicago office.

C. F. HORNEFFER, chief draftsman of the Austin Co., Cleveland, will be engineer in charge of design and construction of a destroyed glass plant at Maubeuge, France, which his company will build for Pilkington Brothers Co., St. Helens, England. Mr. Horneffer will organize his engineering staff and undertake the design entirely in England, employing English engineers.

R. H. FORD, engineer of track elevation, Chicago, Rock Island & Pacific Ry., Chicago, has been appointed principal assistant engineer with headquarters at the same point. The office of engineer of track elevation has been abolished.

CAPT. H. K. TALBOT, of the Construction Division of the Army, has resigned and accepted a place in the selling organization of the Koehring Machine Company.

JOHN F. GREENE, formerly construction engineer, Carter-Halls-Aldinger Co., Winnipeg, Man., has become associated with the firm of C. D. Howe & Co., consulting engineers of Winnipeg and Port Arthur, as manager of the Winnipeg office, in charge of bridge and structural work.

CAPT. JOHN H. ANDERSON, of the 212th Engineers, formerly of the technical staff of the Universal Portland Cement Co., has received his discharge from the Army and has become field engineer in the paving-plant department of the Lakewood Engineering Co., with office in Cleveland.

CHARLES A. POHL has finished his work as head of the Concrete Shipyard Construction Section, Emergency Fleet Corporation, and has returned to general engineering practice in New York as a member of the firm of Bogart & Pohl, civil engineers. He will give his attention largely to hydraulic and steam electric powers, water-front developments and manufacturing plants.

L. C. WELCH, chief engineer of the Midwest Refining Co., Casper, Wyo., has been appointed manager of the paraffine oil department of the company.

E. B. FORD, office engineer, Great Northern R.R., with headquarters at St. Paul, has been appointed assistant engineer, northwestern region, with headquarters at Seattle, succeeding T. G. Hastie, who has been appointed resident engineer, Great Northern R.R., with headquarters at Great Falls, Mont.

CAPT. FREDERICK L. JONES, Construction Division, U. S. A., has been discharged from the service and has returned to his work in the firm of Jones & Hazel, engineer-appraisers, Watertown, N. Y.

T. G. HASTIE, assistant engineer, northwestern region, United States Railroad Administration, with headquarters at Seattle, has been appointed resident engineer, Great Northern R.R., with headquarters at Great Falls, Mont.

CAPT. JOHN P. WENTWORTH, Sanitary Corps, U. S. A., has received his discharge from the service and has returned to his former position as assistant engineer with Metcalf & Eddy, consulting civil engineers, Boston.

MAJ. E. L. DEACON, Air Service, U. S. A., formerly superintendent of construction, George A. Fuller Co., Detroit, has organized the E. L. Deacon Construction Co., with headquarters in Detroit.

CHARLES CARROLL BROWN, formerly of *Municipal Engineering*, has been appointed assistant maintenance engineer, Division of Highways, Illinois Department of Public Works and Buildings.

CAPT. EDWARD WRIGHT, JR., Sanitary Corps, U. S. A., having received his discharge, has returned to his former position as assistant engineer, Massachusetts State Department of Health.

LIEUT. ROBERT GOELET CARRAWAY, U. S. A., recently returned from overseas, has received his discharge from the service and has resumed his work as managing engineer, Henry Exall Elrod Engineering Co., Dallas, Tex.

E. E. SANDS, for the past five years city engineer of Houston, Tex., has resigned to enter private practice with headquarters in New York City, specializing in port and terminal development. He is a graduate of the University of Wisconsin, and for a number of years was connected with the United States Reclamation Service in the West, and with the Canadian Pacific Ry. Land Development Department.

LIEUT. GEORGE A. MCCLELLAN, U. S. A., has been discharged from the service and has become associated with the Henry Exall Elrod Co., Dallas, Tex., as highway engineer for the northern and eastern portions of the state.

W. D. SHANNON, inspector of hull fabrication, American International Shipbuilding Corporation, Hog Island, Penn., has resigned to return to his work with Stone & Webster in Boston.

HAVEN C. KELLY, divisional superintendent, track and roadway, Chicago City Ry., has been appointed superintendent of the department.

OBITUARY

RALPH H. BROWN, vice-president and chief engineer of the Eastern Bridge & Structural Co., Worcester, Mass., died in that city Feb. 22. He was graduated from the Thayer School of Civil Engineering in 1885, previous to which he had served in the engineering department of the Painesville & Youngstown R.R. and in the office of the city engineer of Youngstown, Ohio. In 1885 he became associated with the Boston Bridge Works as assistant engineer, six years later becoming engineer in charge of the estimating department. From 1894 to about 1900 he was chief engineer of the company. He afterward became associated with the Eastern Bridge & Structural Co., of Worcester, and became vice-president and chief engineer.

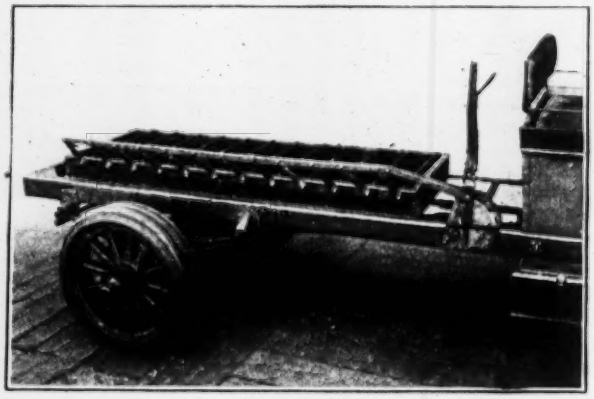
FREDERICK HOBART, for many years a member of the editorial staff of *Engineering and Mining Journal*, died in Flushing, N. Y., Mar. 9, in his 77th year. He had been in retirement since 1917. Immediately following his graduation from the College of the City of New York, he entered the Federal Army in the 9th New Jersey Cavalry, attaining the rank of captain. Returning to civil life, he became connected with the Jersey City Locomotive Works and was afterward assistant editor of the *Railroad Gazette*. He joined the staff of *Engineering and Mining Journal* as assistant editor in 1893.

GEORGE WELSBY SCOTT, consulting engineer, Chicago, died Feb. 28 in Battle Creek, Mich. He had been engaged largely in appraisal work and at one time was associated with the Pullman Company.

Dump-Bottom Truck Body for Spreading Road Material

As a byproduct of his work as a highway engineer, W. L. Goodwin, 1515 N. 40th St., Seattle, has invented a device for spreading road material from a moving truck. It consists of a truck body bottom made of a steel frame with pivoted steel plate panels resembling in principle the old-fashioned wooden window shutter.

The bottom of the truck is made of steel channels forming a frame, which holds the cross-plates. There are 12 plates, each 8 in. wide, made of ¼-in. iron and with a 1 x 1½-in. strengthening rod which acts as an axle. The picture shows how each of the panels is fastened by a crank handle to a longitudinal bar connecting all of them together. To the end of this bar is connected the lever which controls the dumping of the truck. This lever locks forward like a wagon brake, pulling all of the small steel panels into a horizontal position so that the bottom of the truck is closed to hold fine material. To dump the load in the truck this handle is released and, as the axis of each steel panel is off center, the weight of the load in the truck is heavier on one side of the axis than on the other, facilitating dumping. As the control lever may be locked at any one of several points, it is possible to leave the panels turned so that the material in the truck will work out gradually and evenly, according to Mr. Goodwin, and thus be distributed over a roadbed without hand labor.



DUMP BOTTOM FOR TRUCK INVENTED BY ENGINEER

The dumping bottom is designed for use with any motor truck or trailer where the machinery underneath the body will not be damaged by the falling material.

The device is now manufactured for local trade by the C. J. Young Iron Works Co., Seattle, Wash.

Hines To Address American Lumber Congress

A general lumber convention or congress, to which all branches of the industry are invited, on Apr. 14-16, will overlap the annual meeting of the National Lumber Manufacturers' Association on Apr. 16-17. Both will be held at the Congress Hotel in Chicago. Walker D. Hines, new director general of railroads, will address the Congress on Apr. 16.

Methods of retail service and the merchandising of lumber will be discussed Apr. 14, problems of manufacturers and distributors on Apr. 15, and questions of Governmental relations on Apr. 16, according to announcement. Lumber men hope that the congress will result in the formation of a national policy for the lumber industry.

TRADE PUBLICATIONS

The Brandell Co., Union Central Tower, Cincinnati, Ohio, has issued a 6 x 9-in. 24-p. catalog which illustrates and describes "The All-Automatic Brandell Concrete Stone Machine."

Dimension drawings for the use of designers are included in a 95-p. book on the Jeffrey bucket conveyor, issued by Jeffrey Mfg. Co., Columbus, Ohio.

"Lighting from Concealed Sources" is the title of an 8 x 10-in. 245-p. cloth-bound book published by the engineering department of the National X-Ray Reflector Co., New York and Chicago. It is "a practical treatment of lighting problems to obtain satisfying illumination and individual effects without exposed light surfaces," and is profusely illustrated with half tones, line cuts, diagrams and tables.

"Insley Steel Guy and Stiffleg Derricks" is the title of Bulletin No. 110 of the Insley Mfg. Co., Indianapolis, Ind., illustrating and describing its products.

The J. D. Fate Co., of Plymouth, Ohio, has issued a series of bulletins covering industrial haulage by classes. The object of these bulletins is to show the application of the Plymouth gasoline locomotive to various industries.

The Joseph Dixon Crucible Co. has issued a pocket catalog listing lubricants and paints and pencils for mill, railroad and automobile use. The catalog also describes pencils.

The Brown Hoisting Machinery Co., Cleveland, Ohio, has issued Catalog K, 1919. It is an 8½ x 11 [illegible]-p. paper-bound book illustrating, [illegible]ribing and giving diagrams and [illegible]ular data regarding the Brownie locomotive cranes.

The Blaw-Knox Co. announces its "products booklet," indicating the fields covered by its products.

"National Pavement—The Right Road" is the title of a 6 x 9-in. [illegible]-p. pamphlet issued by the Permanent Highways Corporation, 50 E. 42nd St., New York City. It gives descriptions, illustrations and references regarding the work done by the corporation in various parts of the country.

The Novo Engine Co., of Lansing, Mich., has issued Bulletin No. 11 describing and illustrating hoisting outfits manufactured by the company.

Steel forms for concrete and monolithic brick pavements, for integral base and curb work, for curb and gutter building, and for beveled edges on concrete roads, are among the subjects included in a new booklet by the Blaw-Knox Co., of Pittsburgh.

Portable air compressor outfits is the subject of Bulletin No. 15 of the Novo Engine Co., Lansing, Mich.

BUSINESS NOTES

The Moore Trench Machine Co., Rockaway, N. J., is about to resume operations with a full force of men, after a period of wartime idleness of about a year.

Export sales of railroad supplies to the West Indies and South America is the field of the M. C. Fairchild Co., with offices at 347 Madison Ave., New York. Mr. Fairchild has been with Fox Bros., New York, in the same field for a number of years.

A. S. Blagden, director, Air Reduction Co. has been elected president, succeeding W. W. Birge. A. R. Ludlow has been appointed vice-president; C. E. Adams treasurer, and M. W. Randall secretary. The Air Reduction Co. manufactures oxygen, hydrogen, nitrogen, acetylene, calcium carbide, and cutting and welding apparatus, under the trade name "Airco."

H. Y. Smith, formerly vice-president of the Kern-Hunter Co., Milwaukee, Wis., is now engaged under his own name in the handling of contractors' and industrial plant equipment, at 1227 First National Bank Bldg., Milwaukee.

The Clydesdale Brick & Stone Co., of Pittsburgh, Penn., announces that on Mar. 1 its office was moved from the Oliver Bldg. to 907-908 Hartje Bldg., Wood St. & First Ave., Pittsburgh.